GEOGRAPHY
of
NEBRASKA

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The State Capitol at Lincoln
Photo by U. G. Cornell

Geography of Nebraska

BY

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PREFACE

There is a lack of geography literature in Nebraska. Various state and United States publications have been issued, but most of them are now not accessible, and none of them were written for use in schools. This elementary text is intended primarily for use in the graded and rural schools. However, its subjects are presented in a way that may recommend the book to general readers as well, in the absence of a more complete treatment of the subject.

The subject matter of the volume is based for the most part on the author's personal experience in the state while working on the Nebraska Geological Survey and for the United States Geological Survey. The author has also obtained data from publications of the following authors: Barbour, Bessey, Blackman, Clements, Darton, Johnson, Lyon, Loveland, Sheldon, Swezey and Todd.

A few references are cited in each chapter. Of these, the topographic maps and folios shown by plate III, though inexpensive, are very important for class studies. The price of the maps is five cents each, or, at wholesale, three dollars a hundred, except the Omaha Specials which are ten cents each. The folios are twenty-five cents each. These and all other geological publications of the National Government when accessible, may be obtained from the Director of the United States Geological Survey, Washington, D. C. Part IV of the XXI and XXII Annual Reports, Professional Papers 17 and 32, and Water Supply Papers 12, 29 and 70 are among the valuable Nebraska references which have been issued by the United States Geological Survey. If accessible, these and volume one of the Nebraska Geological Survey should be consulted freely by the teacher.

I am indebted to Professor E. H. Barbour, Director of the Nebraska Geological Survey, and to N. H. Darton, of the United States Geological Survey, who have very generously permitted me to publish data which has been collected for use elsewhere.

Thanks are due Miss Bertha L. Green, Principal of the Clinton School, Lincoln, Nebraska, and Miss Emily Guiwits, Secretary to the Chancellor, The University of Nebraska, who edited the manuscript, placing it in a form which is suited to the seventh and eighth grades of the public schools.

The questions at the end of each chapter were prepared by Edward C. Bishop, Deputy Superintendent of Public Instruction. They are intended to stimulate observation and discussion. Some of them can be answered from the text, but many require original thought. though none of the questions are difficult.

The special critics for the text were:

N. A. Bengtson, Professor of Geography, The Nebraska State Normal, at Peru.

William G. Bishop, Professor of Geography and Agriculture, The Nebraska Wesleyan University.

George A. Loveland, Division Director of the Weather Bureau, The University of Nebraska.

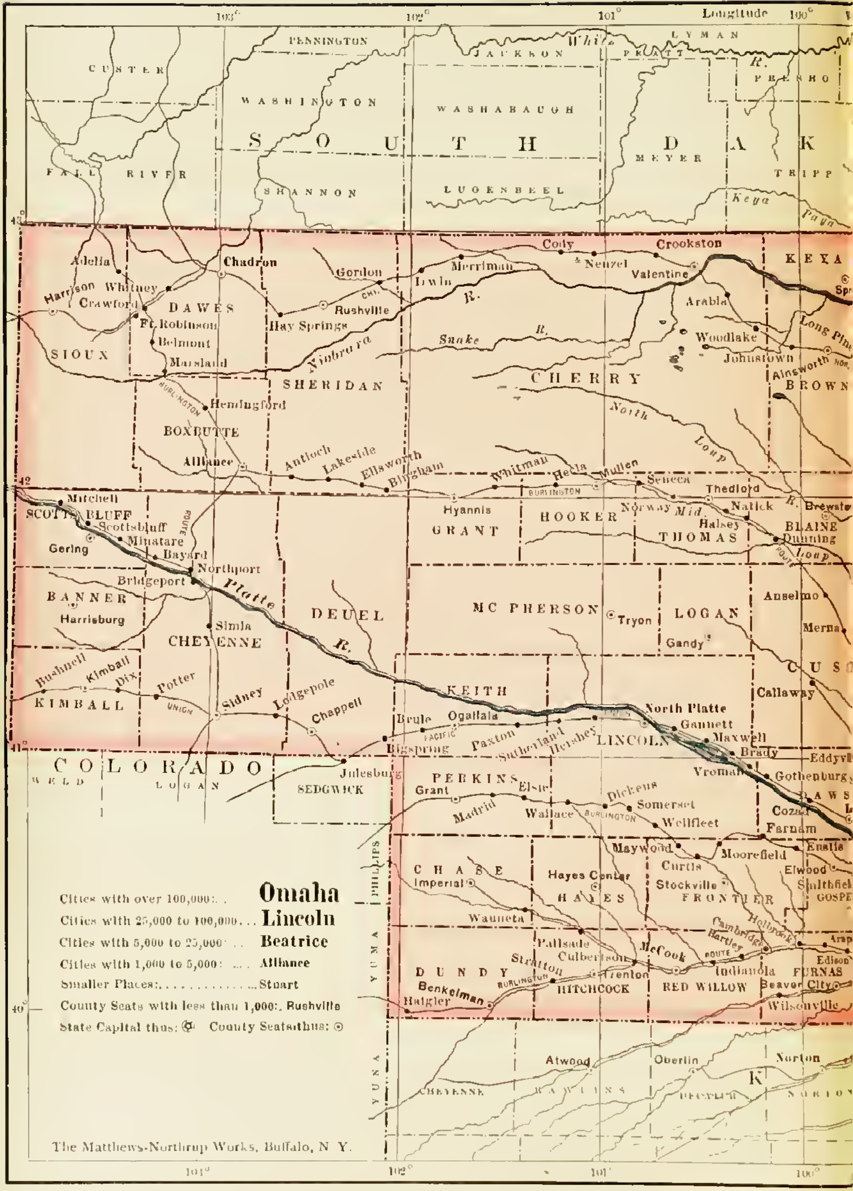
Andrew J. Mercer, Professor of Geography and Agriculture, The State Normal School at Kearney.

W. L. Stephens, Superintendent of Schools, Lincoln.

For photographs, acknowledgments are due Professor E. H. Barbour, E. C. Bishop, U. G. Cornell, N. H. Darton, Professor R. A. Emerson, A. E. Sheldon, C. E. Dwyer, and the State Historical Society. Photographs not thus credited were with three exceptions taken by the author.

Miss Maud Cheuvront, Mrs. G. E. Condra and Mr. Philip J. Harrison have rendered valuable assistance in the preparation of manuscript and figures. GEORGE EVERT CONDRA

The University of Nebraska
March 8, 1906



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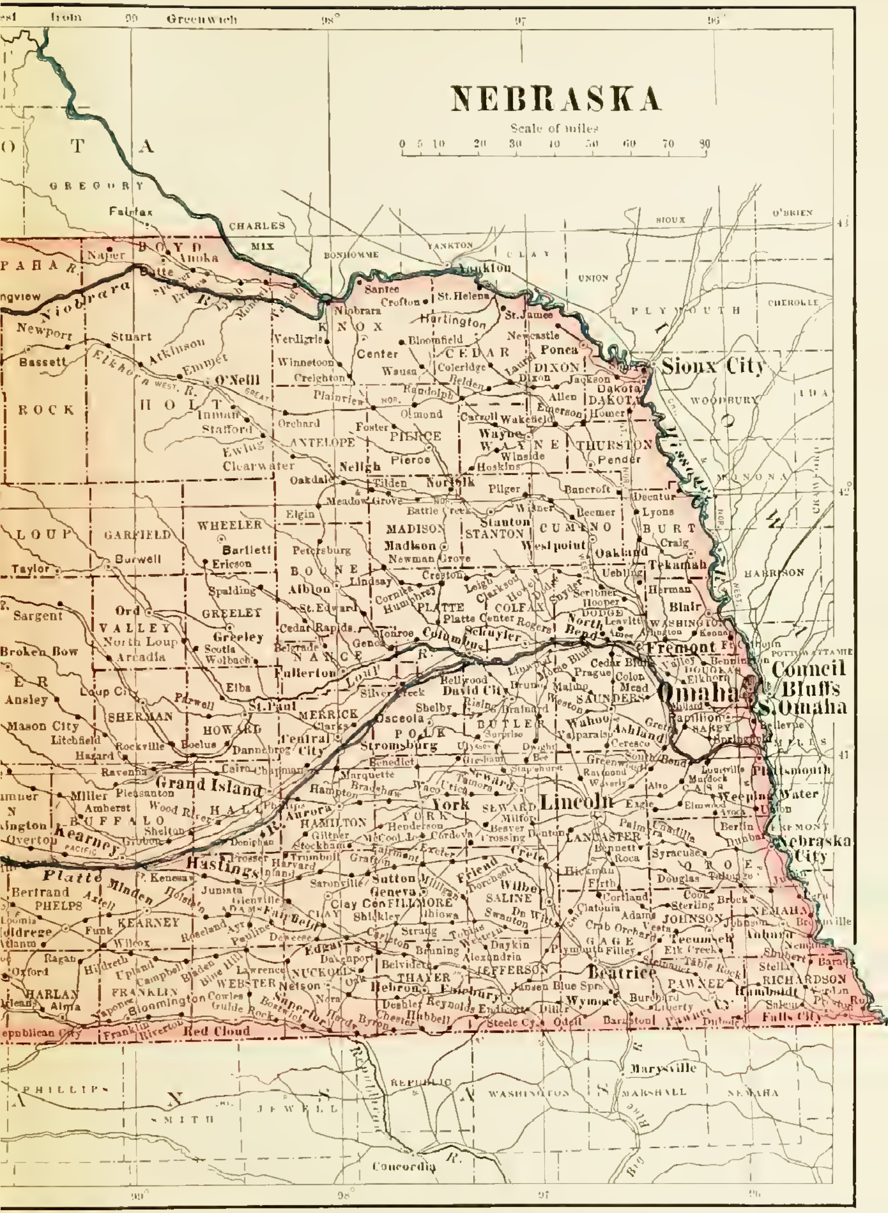
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Millard
Papillion
SARPY
Bellevue
Springfield
Ansley
Loup City
SHERMAN
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St. Paul
Elba
Silver Creek
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Gretna
Mason City
Litchfield
Hazard
Rockville
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Boelus
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Central City
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Ulysses
Dwight
Ceresco
South Bend
Louisville
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Greenwood
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Weeping Water
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Western
Daykin
Alexandria
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Vesta
Tecumseh
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Geographic Influences. We know how people live in warm and in cold countries, and we have read something of dry and of moist climates, and their effects upon living things. Usually a country with little rainfall is not the best for agriculture. We know also about swamp and well-drained lands, and something of fertile and of worn-out soils. These may be fit or unfit for certain uses. In some countries there are smooth lands, and also those that are too rough for farming or travel. We have seen how well-water and building-stone are obtained from under-ground. In this book we are to learn whether Nebraska has fertile soil, good roads, good well-water, mineral fuel, building materials, and enough rainfall. These are called favorable geographic influences. We are to study

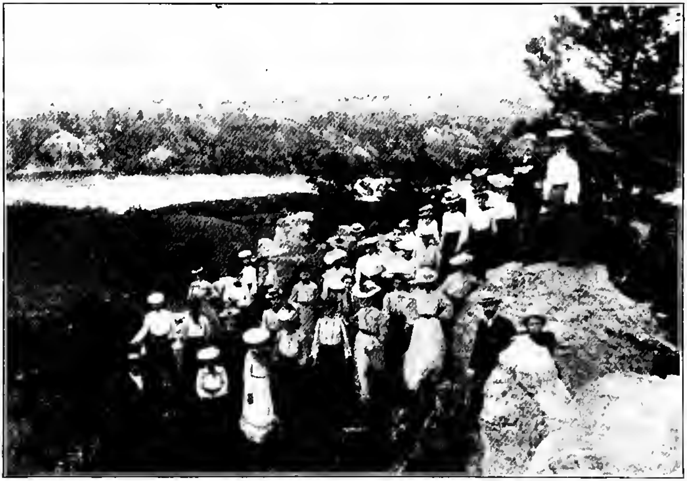

FIG. 1. TEACHERS OF THE VALENTINE JUNIOR NORMAL ON AN EVENING EXCURSION. IN THE DISTANCE IS LAKE MINNACHADUZA

also the structure, weather, climate, ground-water, drainage, and topography of our state, for these control quite largely our resources and industries. The native grasses and trees are adapted to the conditions under which they live and in turn are of use or service to man.

Importance of Home Studies. We should not forget that the places where we live are parts of Nebraska. It will not be possible for all who read this book to see the whole of Nebraska, but each may study his home region and compare it with other parts of the state. As we read of rivers, crops, and other things, let us note how they are like or unlike the same things near our homes. The study of the geography of Nebraska should interest us in our home geography, which, in some cases, is described in this volume. We may find it possible to make excursions to places of interest and there study things as they are out-of-doors. (Figures 1 and 2)

FIG. 2. A CLASS OF TEACHERS STUDYING GEOGRAPHY IN THE FIELD

Location of Nebraska. Where is Nebraska? Most of us will say that the state is where we live. This answer is correct for persons living in Nebraska. But what is the position of our state in the United States? What is its exact location, its longitude and latitude, and what is its position in its relation to the Rocky Mountains and to the Mississippi basin?

By examining a map of the United States we may see that Nebraska is a little north of the center of the United States. It lies between the meridians of longitude 95° 25′ and 104° west of Greenwich, and the parallels of latitude 40° and 43° north of the equator. It is in that part of the Mississippi basin which slopes eastward from the Rocky Mountains. The western part of the state is in the Great Plains region, and the eastern part in the prairie region. Under another heading we shall learn that the Missouri River is not an exact boundary line, and that portions of Nebraska are east of that river.

Extent and Area. Nebraska is one of the largest states in the Union. (Plate I) The extreme length is over 450 miles and the width about 207 miles. The distance from Omaha to the west line is about 425 miles. The greatest extent in the state is from northwest to southeast, a distance of over 500 miles. The area, according to the United States Geological Survey, is about 77,510 square miles, which is 22,010 square miles greater than that of Rhode Island, Delaware, Connecticut, New Jersey, Massachusetts, New Hampshire, Vermont, and Maryland combined; the area of the six New England states is not so large as Nebraska by about 11,045 square miles. The size of our state seems to be changing very slowly, therefore we cannot give the exact figures. The Missouri River is cutting away the land on its right bank faster than on the left; thus entire farms have been destroyed in northern Knox, Cedar, and Dixon counties. At a bluff called Ionia, in Dixon County, the river is said to have shifted to the right fully one-fourth of a mile within fifty years.

Boundaries. The bordering states are South Dakota on the north; South Dakota, Iowa, and Missouri on the east; Kansas and Colorado on the south; and Colorado and Wyoming on the west. The natural boundary line on the east is the main channel of the Missouri River. If this river did not change its position, the exact dividing line between Nebraska and the bordering states to the east would be located without dispute. But the stream is not a stationary boundary line. It has shifted its channel as much as a mile within a year. A very good example of such change is found at Omaha. Formerly the Missouri flowed through what is now Cut-off Lake, just north-east of the city; later, the river straightened its course by cutting across the neck of this big loop or bend, leaving the lake in the old channel, and transferring a part of Iowa to the west side of the river. (Plate IV) In a similar manner the river has shifted its course at other places, leaving portions of our state on the east side of the stream.

Nebraska's boundaries were changed several times during its territorial history, and once since its admission to the Union as a state. The original territory of Nebraska extended westward to the crest of the Rocky Mountains.

Boundary Disputes. Certain lands along the Missouri are claimed by two states. It seems an unusual occurrence for one's land to be transferred from one state to another without the consent of the owner, but this has happened at several places along the Missouri River. The owner of a farm should know what state and county he lives in, so that he may vote at the right place and pay taxes to the proper officials. So disputes have arisen, some of which are not yet settled.

By a decision of the United States Supreme Court, the land enclosed by Cut-off Lake at Omaha (Plate IV) is to remain a part of Iowa, though it is now on the Nebraska side of the river.

Vertical Position and Surface Slope. The altitude of Nebraska may be called its vertical position. (Plate II) It is the elevation above sea-level. The highest parts of the state are in Banner and Kimball counties, along the western border, where a few places exceed 5,300 feet in altitude. The lowest part is in the southeast corner of Richardson County, with an altitude of less than 850 feet. The slope of the state as a whole is from west to east, but in the eastern counties it is to the southeast. The average altitude along the Nebraska-Wyoming line is nearly 5,000 feet, while the average altitude of the highest land bordering the Missouri River from Dakota county southward to the Kansas line is a little over 1,200 feet.

Topographic Regions. We usually think of Nebraska as a "gently rolling" prairie. Such a description applies very well to certain parts, but not to the state as a whole. As we continue our study we shall read of very rough lands, some of which are called mountains.

From the character of the surface our state may be divided into four regions. (Plate II) They are the Loess, Sand Hill, High Plains, and the Bad Lands. Each differs from the others in a number of ways, but principally in topography. The regions are described in chapters VII, VIII, IX, and X.

Topographic Survey. About one-half of Nebraska has been carefully surveyed and mapped by the Topographic branch of the United States Geological Survey. The maps shown by plate III should be secured and studied as a reference by all who use this text. They may be purchased from the Director of the United States Geological Survey, Washing-

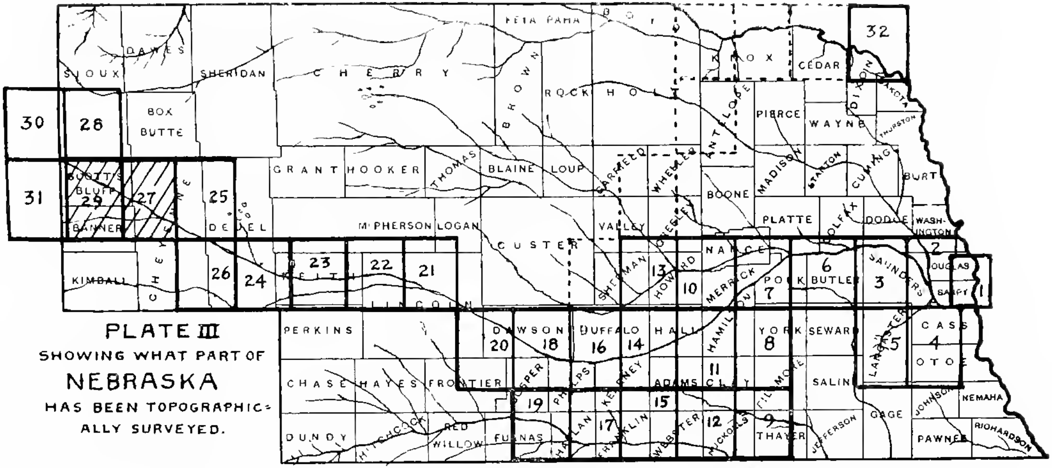

PLATE III
SHOWING WHAT PART OF
NEBRASKA
HAS BEEN TOPOGRAPHIC-
ALLY SURVEYED.

□ MAPS PUBLISHED.
⬚ MAPS NOT YET PUBLISHED.
▨ FOLIOS PUBLISHED.

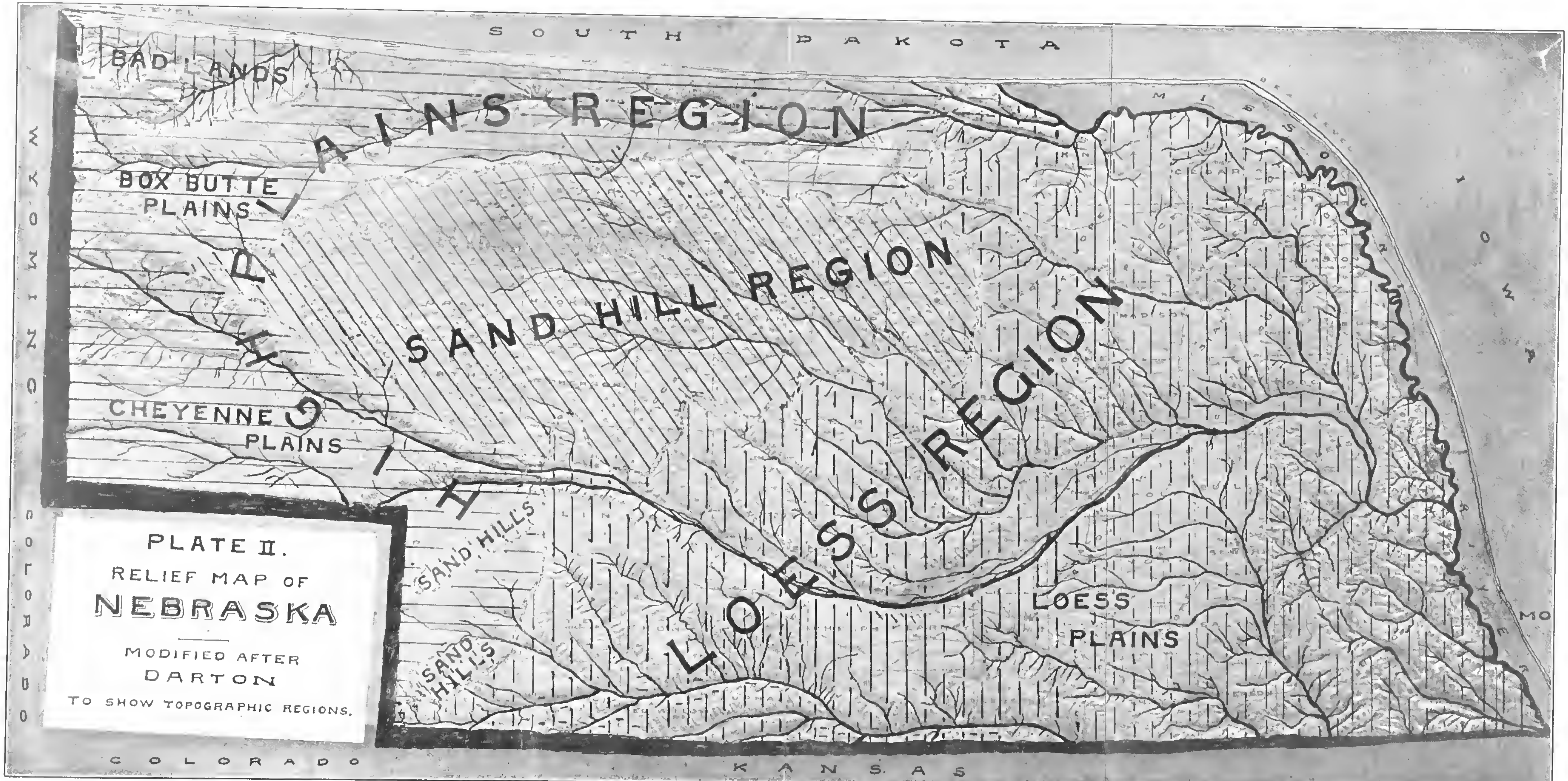

PLATE II.

RELIEF MAP OF

NEBRASKA

MODIFIED AFTER DARTON

TO SHOW TOPOGRAPHIC REGIONS.

ton, D. C., at five cents each for the standard size, or by wholesale, three dollars per hundred, except the Omaha specials, which are ten cents each.

QUESTIONS AND EXERCISES

1. Why is a knowledge of the geography of the home state of much importance?

2. What benefits come to us from a knowledge of Nebraska's resources and industries?

3. Question for debate: "Resolved, That geographic conditions influence people more than the people affect their environment."

4. Compare the size of Nebraska with that of Maine; of Ohio; of Texas.

5. Do you know what causes the Missouri River to cut its right bank more than its left bank?

6. Is there a "cut-off" near your home? If so, describe it and tell how it was formed.

7. Where are the highest and the lowest points in your county?

8. What is a topographic region? A relief map? A topographic map?

9. In which topographic region of Nebraska do you live?

10. What kinds of trees and rocks do you see in figure 1?

CHAPTER II

STRUCTURE OF NEBRASKA

We are to learn something of the soils on the surface and of the rock beds which lie beneath the surface of the land. The story of this underground structure is very interesting, and is best told in geology,[1] but we are most concerned now with the different kinds of rock which occur beneath our soil and the manner in which they are arranged. We should learn these things because the rocks are important to us in several ways. For one reason, men must obtain materials with which to build bridges, houses, and cities; and many of these building materials come from the rocks. There are other reasons why we should know more of the structure of our state; these reasons we shall learn as the subject is studied further.

Mantle Rock. Much of the state is covered by a mantle or blanket of soil and loose rock materials, which at most places entirely conceals the underlying and firmer rocks. The depth of this covering varies from a few inches to about two hundred feet. There is no place in our state, however, where this mantle of soil, clay, sand, and gravel does not lie on beds or layers of rock; this underlying rock is called the bed-rock.

Rocks below the Surface. If we should sink a deep well anywhere in the state, it would reach bed-rock. Have you noticed the materials thrown out when cellars and wells were dug? Did the rock change in color and in kind with depth?

---

[1] Barbour, E. H., Nebraska Geol. Survey, vol. 1, pp. 116-178.

A place where the layers of rock protrude at the surface is called an outcrop. Very good places to see the outcrops are at quarries, in river valleys, and in some railroad cuts. If the rocks are in layers, they are said to be stratified. If the beds or strata have a nearly level position, they are horizontal; otherwise they tilt or "dip" in some direction. It is also of value for us to learn the kinds of rock. Have you seen rock beds outcropping? If so, what kinds, and were they used for any purpose?

Stratified Structure. We do not know just how thick the strata are in Nebraska. An artesian well at Lincoln is over 2,400 feet deep, and it does not reach through all of the beds of limestone, sandstone, clay, and shale. Still deeper down there is a very different kind of rock, which is granite; thus far no one has drilled to it in our state. The outcrops in the Platte, Missouri, and Republican valleys are composed of stratified rock. Do you know of other exposed rock beds? If so, have you followed along them for a mile or more? Did you see the same kinds in both sides of a ravine or valley, and do you know how far in the land each bed extends? Men have drilled through the mantle rock and into these rock beds several miles distant from their outcrops. This tells us, then, that strata extend through the state. Some of the best known beds pass entirely through Nebraska and outcrop again in other states. We are now ready to define the structure.

Beneath a rather thick mantle rock, Nebraska is composed of extensive beds of limestone, chalk, sandstone, clay, and shale, which lie one upon another in a nearly horizontal position. The oldest rocks exposed are in the southeastern part. They are overlaid while passing westward and northwestward by more recent formations, as shown by figure 3.

Principal Rock Formations. Nebraska boys and girls should know something of the main kinds of rock which compose the formations that make up the structure. In some states the school children talk as familiarly about the different kinds of rock as they do of the flowers or birds. We wish at least some acquaintance with our most useful formations.

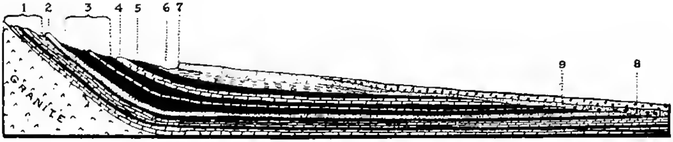

FIG. 3. IDEAL SECTION FROM SOUTHEASTERN NEBRASKA TO THE BLACK HILLS

1, Carboniferous and Older Beds; 2, Dakota Sandstone; 3, Benton Shales and Limestone; 4, Niobrara Chalk Rock; 5, Pierre Shale; 6, The Bad Land Clays; 7, Pine Ridge and the Tertiary Sands; 8, Glacial Deposits, 9, The Loess.

Carboniferous Strata. The oldest rock beds exposed in the state come to the surface along valleys in the southeastern counties, where they are known by geologists as the Pennsylvanian and Permian series of the Carboniferous system. These strata are mainly limestones and shales (Figure 4), the former composed for the most part of shell-like fossils which were once the skeletons of marine animals. Between the limestone strata are beds of shale, some dark, others light to yellowish in color. The shales were made from mud deposited in the sea. At places thin beds of coal and sandstone lie between the shales and limestones. The Carboniferous rocks are very old and more than 2,000 feet thick in Nebraska. The layers pass under newer formations to the northwest, become deeply buried in central and western Nebraska, then rise to the surface in the Black Hills and in

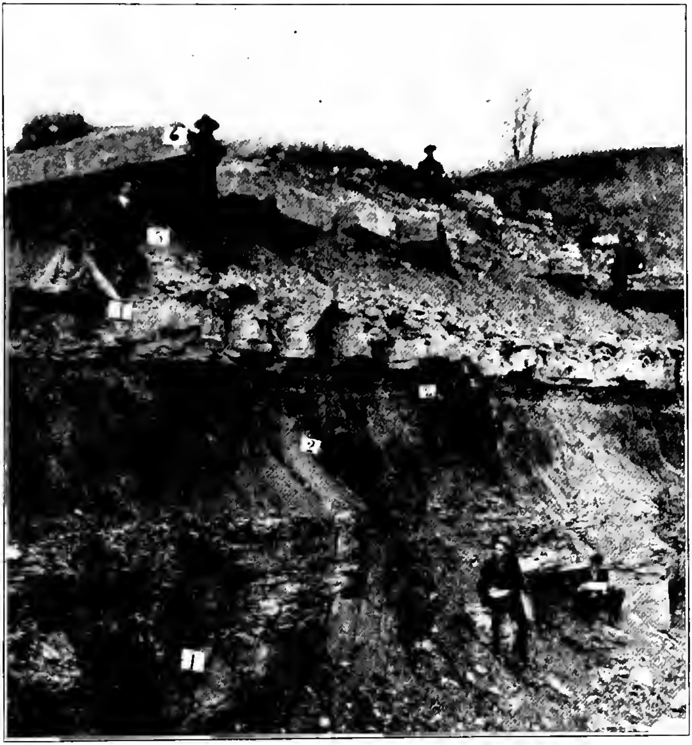

FIG. 4. A CLASS OF YOUNG MEN STUDYING THE PENNSYLVANIAN STRATA NEAR LOUISVILLE

the Rocky Mountains as shown by figure 3. These Carboniferous rocks were so named because they contain at places as in Iowa and Missouri much carbon in the form of coal. In Nebraska the Pennsylvanian or lowest and oldest series outcrops prominently near Plattsmouth, Weeping Water, Nebraska City, and Falls City, where these rocks may be seen and studied. Permian strata, being much like the underlying Pennsylvanian beds, lie next above the latter and outcrop prominently in the Big Blue Valley near Beatrice, Blue Springs, and Wymore

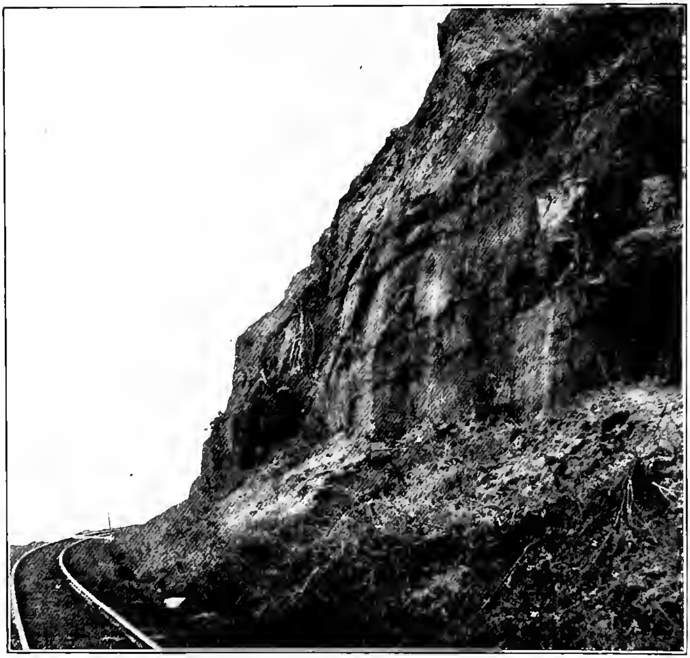

FIG. 5. DAKOTA SANDSTONE IN A LARGE BLUFF NEAR THE MOUTH OF SALT CREEK

Dakota Sandstone. This formation is next above the rocks just described, and is seen by many boys and girls in eastern Nebraska, Kansas, and South Dakota. It is composed principally of a yellowish or rusty-looking sandstone, and of clay beds, light colored to mottled in appearance. Figure 5 shows how the sand rock looks in a high bluff about two miles below Ashland. Other and somewhat similar views are found near Endicott, Fairbury, Beatrice, Lincoln, Tekamah, and Ponca. The formation was first described in Dakota County, hence it was named the Dakota formation. This stone is not very good for building purposes, but the clay is used in brick making. These beds extend westward through Nebraska, rising high in ridges about the Black Hills and along the eastern border of the Rocky Mountains. Later we shall learn of a further use of this sandstone in Nebraska.

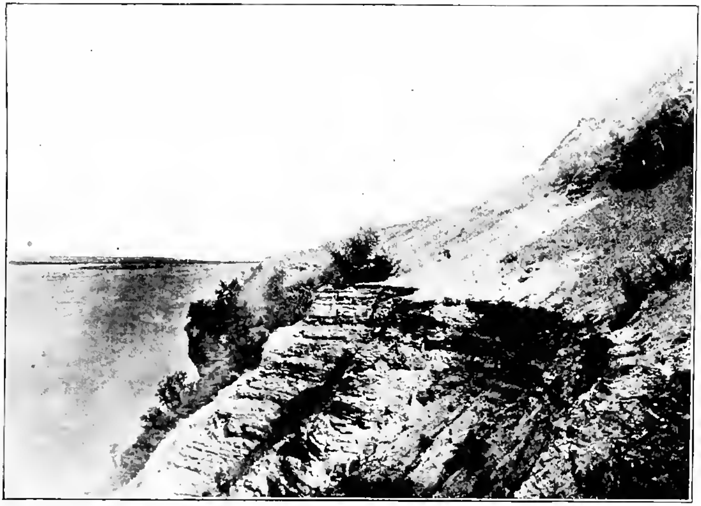

FIG. 6. CHALK BLUFFS ALONG THE MISSOURI RIVER, BOYD COUNTY. THE UPPER BEDS ARE PIERRE SHALE

Benton Shales and Limestone. These are next above the sandstone just described. The shales, usually dark in color, lie both above and below a limestone ledge which is composed of many millions of oyster-like shells. Some of us have seen these very old oysters in the rock at places in Thayer, Jefferson, Seward, Dakota and Dixon counties.

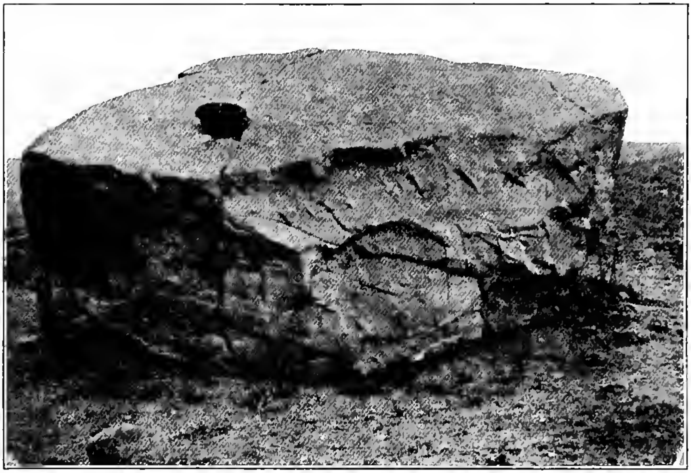

FIG. 7. LARGE GLACIAL BOWLDER NEAR FAIRBURY

The limestone is quarried, but the shales have no important use. The shales, where they outcrop in the northeastern part of the state, contain many clear gypsum crystals. There, the school children enjoy collecting the crystals for cabinet specimens.

Niobrara Chalk Rock. This chalk is bluish gray in the rock beds and yellowish where it is weathered on the bluffs. It is very soft and easily cut with a knife. The thickness of the formation varies from 200 to 450 feet, lying just above the Benton strata. The chalk is exposed prominently along the Missouri River in Boyd, Knox and Cedar counties and along the Republican from southwest of Superior to Alma. In some respects it is our most interesting formation. Many people do not know that there is so much chalk in Nebraska, even more than in England. Figure 6 shows the chalk bluffs along the Missouri River in the northern part of Boyd County. The formation was named from the Niobrara River, near the mouth of which it forms high bluffs. The stone is sawed out and used at places but is too soft for most building purposes.

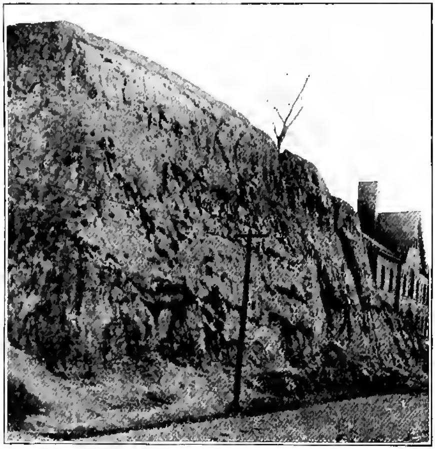

FIG. 8. LOESS IN A STREET CUT AT OMAHA
Photo by E. H. Barbour

Pierre Shale. Resting upon the Niobrara chalk rock is a thick formation composed mostly of dark alkaline shales or clays which feel soapy when wet. These beds have been called soapstone and gumbo. The formation outcrops above the chalk rock (Figure 6) along the Missouri in northern Knox and Boyd counties, along the Republican from near McCook to the Colorado line, and in the northwestern corner of the state. The name is a very old one coming from a town in South Dakota which was named for an early explorer.

Surface Beds of Clay and Sand. The surface rock in western Nebraska is composed of thick layers of sand (Figure

55) below which are clays several hundred feet thick. The latter outcrop in the Bad Lands in the northwestern corner of the state. At places, the upper or sandy beds contain pebbles and ledges of a light colored rock.

Glacial Deposits. These materials, called Till, were carried into the state by large glaciers. They are clay, sand and, at places, pebbles and bowlders, which lie on and conceal many of the rock beds in the eastern part of the state. This mantle rock varies from a few feet to over 100 feet in thickness. At places it is composed principally of a brownish clay, as at Omaha, where it is usually confused with the overlying Loess. Some of us have seen large glacial bowlders in the Till of the eastern counties. (Figure 7) The largest known one of these, about 20 feet in diameter, is located about three miles northeast of Humboldt in Richardson County.

Other Kinds of Surface Rock. The buff-colored, fine-grained subsoil of eastern, southeastern and southern Nebraska is the Loess. (Figure 8) It resembles the finer materials of the Till, but contains no pebbles. Agriculturally it is our most important formation.

The dune sand formation is in north-central Nebraska. The alluvial or flood plain formation occurs in valleys forming their bottom land. In other chapters we shall read more of each kind of surface rock, especially of the Loess.

QUESTIONS AND EXERCISES

1. Of what materials are buildings in your neighborhood made?

2. Do you know how many of these materials were secured in Nebraska?

3. Make a collection of the different kinds of building materials produced near your home. Label each specimen, giving its name and the place where it was obtained.

4. What kind of mantle rock do you have near your home? How thick is it? Do rocks outcrop near your home? If so, where and what kinds?

5. Add to your collection as many as possible of the rocks described in this chapter.

6. Can you find limestone containing shells or other fossils?

7. Where is the deepest well in your neighborhood? Does it extend into beds of rock? If so, what kinds? (Ask well drillers.)

8. What does figure 4 show? Why are the boys using the numbers?

9. Do the oldest rocks of Nebraska pass under your county? (See Figure 3.)

10. Compare figures 5 and 6. Why do these bluffs differ?

11. Find a glacial bowlder if you can. Does it resemble any of the rock you have seen outcropping?

12. What is subsoil? Is there any Loess soil near your home? If so, describe it.

13. Have you seen alluvial, sand hill or stony soil? If so, give description.

14. What is Till? Do you know what states it covers?

CHAPTER III

STORY OF THE STRUCTURE

In chapter II we learned how Nebraska looks beneath the surface. How did these layers come to be as they are? Let us read the story of their origin and structure.

The Older Strata. The oldest beds that outcrop in our state were nearly all made in the sea. The limestones are composed chiefly of sea shells. An examination of almost any piece of this rock will show such shells or fossils in it. They are the skeleton remains of creatures that have lived in the ocean. As snow, flake by flake, may make a covering many inches thick, so these shells settling to the bottom of the sea, in time, made a shell bed many feet deep. This took long ages, too long to think of; but it shows us that for all that time the sea extended over what is now Nebraska. The shales and clays between the limestones were also deposited in the ocean, but were formed from mud which was washed in from the land and slowly settled to the bottom. The rocks are stratified because they were deposited in water as layers of sediment. The material which forms the thin coal beds were once plants growing in swampy places and then peat which after being covered by mud and shells became coal. Sandstone is composed of sand, hence the name. It was carried to the sea by rivers. We wish also to learn of the other changes in sea and land which took place here many ages ago.

Elevation Eastward. After these older strata were deposited in the sea and shallow water, the land northeast and east of Nebraska was elevated. We do not know just what caused it to be raised out of the ocean, but we do know that land appeared where once was sea. The eastern part of our state also was raised, becoming land at that time. The slope and drainage was from Iowa westward to an interior sea which then covered all of central and western Nebraska, and extended from the Gulf of Mexico to the Arctic Ocean.

The Interior Sea. For long periods of time rivers carried sediment into this great body of water and deposited it there. The oldest beds then formed now lie far below the surface of the western counties and are nowhere exposed in that part of the state. The Dakota sandstone was built up from sand washed by streams into a shallow sea and strewn widely over its floor, but not until the land surface in the eastern part of Nebraska and western Iowa had been depressed to or below the sea level. After this time the waters deepened and the ocean floor was covered with great beds of clay and a thin formation of limestone known as the Benton. Then for ages shells of small marine animals which flourished in the ocean were dropped over the sea floor forming the Niobrara chalk rock. The next sediment added was that of the Pierre shale which is now a thousand feet thick in places. The time which it took to fill this great arm of the sea must have been very long, for the rock beds made in it are fully half a mile thick in the western counties.

During most of this time large sea serpents and numerous other animals very different from any animals of the present time lived in this sea. Their fossils are found in the rocks. Slowly the sea of central and western Nebraska was filled with sediment; it grew shallow and finally disappeared.

Elevation Westward. After the interior sea had decreased somewhat from its former great size, much of its floor was lifted to dry land high above the ocean, and the rock beds farther west were pressed or folded upward into prominent ridges of the Rocky Mountains. By this change the western end of Nebraska became higher than the eastern part and the drainage turned to about its present direction. We have thus seen how the sediment of shells, clay and sand was built into rock beds which in turn were elevated forming the land of our state. The surface as it appeared then was land, but not soil as we now find it.

Wash from the Mountains. Not all portions of the elevated ocean floor became dry land at once; indeed, in the northwestern and western counties lakes seem to have existed for a long time. Sediment which washed into them from all directions formed the Bad Land clays, to be described later. Finally, however, the lakes were filled with mud, and the rivers which flowed eastward from the mountains across our state, carried much sediment, principally sand and gravel, and deposited it over all of the central and western counties. But what caused the rivers to drop their load of sediment there? Geologists tell us that it was the result of a very dry climate which then prevailed in western Nebraska. Rivers flowing eastward lost their water by evaporation, hence they could carry the sand and gravel no farther. They flowed from a moist to a dry region and deposited their load where their water disappeared by evaporation. The banks of the rivers were low and sandy; the streams overflowed right and left, gradually lifting the land to an even eastward slope. So the thick, sandy surface formations of the west were built high and smooth out of sand and pebbles which the rivers carried east from the mountains.

Glacial Invasion. After these thick clay and sand beds were formed, a great ice sheet called a glacier pushed southward over the eastern part of the state. At first the glacier advanced across the entire width of the state; then after melting back northward it seems to have moved part way across again. We do not know just how far west the edge of the ice sheet reached in our state, but it extended somewhat beyond a line joining the eastern boundaries of Boyd, York and Thayer counties.

What did the glaciers have to do with the structure and geography of Nebraska? While moving southward they scraped hard on the rocks; the scratches and grooves thus made in the bed rock tell us the direction of their movement. A second result is yet more important, namely, that much broken rock, as clay, sand, pebbles and bowlders, which accumulated on the glaciers as they plowed their way through Minnesota and the Dakotas, was carried into Nebraska and dropped as the ice melted. These materials are called glacial drift or Till. Most of the Till thus brought from the north is quite unlike the stratified beds upon which it lies and the sands with which it is mixed at places.

As the ice pushed southward across Nebraska it completely filled the valleys in its path. It must have formed great dams across the rivers which flowed eastward in the state and caused them to overflow southward along the west edge of the ice sheet.

The sediment of these east-flowing rivers was deposited first, in their valleys, filling them, and later along the overflow channels at the border of the ice dams, mixing with glacial materials which had been carried from the north.

After the glaciers melted northward to Dakota, the Loess was spread over the Till. Just how the Loess was brought to its position, we do not know. A part may have been blown in by wind, but most of it seems to have been deposited by overloaded rivers. It lies on the Till in eastern counties, but is usually finer in texture and lighter in color than the glacial clay.

We know something now of the structure of the land beneath us and something of its origin. Next we are to study Nebraska weather.

QUESTIONS AND EXERCISES

1. How were the principal rock formations made in the sea? What caused them to be stratified?

2. How do we know that for long periods of time the sea extended over what is now Nebraska?

3. How has Nebraska changed in altitude? In slope, and in directions of drainage?

4. Of what is shale composed? Limestone? Sandstone?

5. How did rivers deposit thick layers of sediment in western Nebraska?

6. What is a glacier? What countries now contain glaciers?

7. Tell the story of the ice sheet which once covered a part of Nebraska.

8. By what means was the Loess spread over eastern Nebraska?

9. Make a collection of the different kinds of sand in your vicinity.

CHAPTER IV

WEATHER OF NEBRASKA

The term weather denotes some condition of the atmosphere in which we live. We talk much about the weather, yet do not always realize the important place it holds in geography. It influences the growth of plants, the lives of animals and the work of man. In order to understand more fully what is meant by the weather and how important a factor it is in the geography of our state, it will be necessary for us to learn the different elements or kinds of weather of which the Weather Bureau makes a continuous record by means of self-recording instruments.

Weather Elements. *Temperature* is one of the most important elements. A self-recording instrument, called the thermograph, which writes a continuous record of temperatures, is used by the Weather Bureau. The types of weather based on temperature are hot, warm, cool and cold. The mean temperature is the average for a day, month or year. The range of temperature is the difference between the maximum or highest and the minimum or lowest temperature. Are the day and night and the seasonal ranges of temperature great or small in Nebraska?

Winds are due to differences in air pressure. Changes in heat and moisture produce differences in the air's weight and pressure and thus cause it to move from places of high pressure to places of low pressure. The Weather Bureau uses a self-recording barometer called the barograph which makes a complete record of all changes in pressure. Still another instrument, called the anemometer, measures the velocity of the wind, while the ordinary weather vane shows its direction.

The types of weather controlled by pressure and wind are represented by the extremes, calm and windy. The moving air may be either cold or warm. This gives us the cold and warm winds.

Humidity refers to the amount of water vapor in the air. If much moisture is present the humidity is high. If the air contains little moisture the humidity is low. When any portion of the air contains all the water vapor it can hold, it is saturated. Warm air will hold more vapor than cold air.

People who study the weather find it necessary to measure the relative dryness or dampness of the air. Relative humidity is the amount of water vapor in the air at any time in proportion to the amount which it could hold without precipitation. The relative humidity is low at dry times and high during rainy weather.

About all we need to observe of this element is whether the air is dry or humid. A very dry, hot air takes much moisture from the crops and causes them to wither when there is little water in the ground.

Sunshine and cloudiness are terms which refer to the condition of the sky with respect to its per cent. of cloudiness. Clouds are formed by the cooling of water vapor. They vary somewhat in form and kind during the day and with the seasons. The dust cloud is of another kind, caused by strong winds lifting fine dust into the air. The types of weather based on cloudiness are clear, partly cloudy and cloudy.

Precipitation is a general term including rain, hail, sleet and snow. The types of weather due to precipitation are to be discussed in connection with the cyclone with which they are associated.

For several years the rainfall of our state has been studied by the Weather Bureau, where the amount of water that falls during each rain is measured in the rain gage. Every twenty four hours in which the precipitation is one hundredth of an inch or more is called a rainy day. It takes from ten to twelve inches of snow to produce one inch of water.

The amount and the distribution of rainfall in Nebraska is the state's strongest geographic influence.

The Cyclone. The weather of Nebraska is said to be cyclonic. In other words, it is controlled largely by the cyclone, by which we do not mean the small destructive tornado, but a large area of air moving in a circular manner from all directions towards a center. Air in the center of a cyclone is not so heavy as that farther out, so the center is called an area of low pressure. Air at a distance from the center is heavier, hence its pressure is greater. One law of cyclones is that their air moves from "highs" to "lows," which is to say that the heavier air crowds out the lighter air. The velocity of the wind varies greatly. In addition to its circular motion, the cyclone progresses eastward across Nebraska the velocity varying from twenty to thirty miles per hour, being greater in winter than in summer. Most cyclones are several hundred miles in diameter They pass over Nebraska at quite regular intervals of from three to four days, taking on an average fifteen to twenty hours to traverse the state. From the above explanation we should now understand why air moves towards the center of a cyclone and why the mercury in the barometer falls and rises as a cyclone passes over us.

Weather of the Cyclone. Figure 9 shows the kinds of weather that may occur in different parts of a cyclone. Pressure is indicated by lines called isobars; wind direction by arrows; and the cloudiness and rainfall by broken lines and shading.

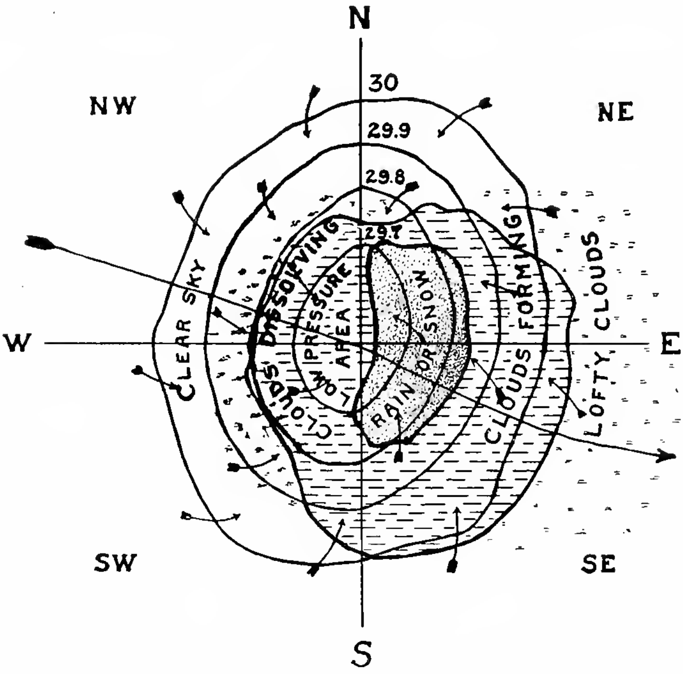

Fig. 9. An Outline Showing the Weather of a Cyclone

It is convenient to speak of the different parts of a cyclone as quadrants. By drawing a straight line from east to west and another from north to south through the center, we represent four parts or quadrants. They are the northeast, southeast, southwest and the northwest quadrants as shown by figure 9.

A cyclone while passing over Nebraska gives the state several kinds of weather. When it is raining or snowing in one part of the state it is not necessarily doing so at all places. Our state may experience fair weather and storms, rain and perhaps snow, all at the same time, but at different places.

The most noticeable feature of cyclonic weather is its quick changes. Each locality is apt to experience a variety of weather at short intervals due to the passage of a cyclone. The Weather Bureau studies and records the movements of cyclones. These enter Nebraska usually from the northwest, pass south of east for most of the distance across the state and then turn northeastward. An approaching cyclone is indicated by a lowering of the mercury in the barometer which is due to a decrease in the air's pressure; as the cyclone passes over us the barometer falls and rises with the decrease and increase of pressure.

Cyclonic Winds. Most winds of Nebraska do not blow in straight lines; they circle into lows or centers of cyclones. We may now ask what causes the wind to change its direction? We have observed these quick changes in direction. A southeast wind after a short period of calm may give way to one from the northwest. Our answer is found in the cyclone, into which air is circling from all directions. As a cyclone approaches us from the northwest we come at first into the southeast quadrant, then into the center, and later into the northwest quadrant. During this time we have southeast wind, calm, and last a northwest wind. In case the center passes somewhat to the north or south of us, the wind does not shift to an exactly opposite direction. Thus the cyclone as it moves across the state brings changes in the direction of wind.

Temperature Changes. Air moving into a region of low pressure varies in temperature in different quadrants, that in the southeast being warmest and the northwest coldest. If the wind continues several days from the southeast a "warm spell" or warm weather prevails. Occasionally this type of weather lingers longer than usual; this occurs when the motion of a cyclone is slow. Air of the southeast quadrant while passing over a dry region at such a time becomes the so-called "hot wind." Then the relative humidity of the air is low, and the principal damage to crops is due more to the loss of their moisture to the atmosphere, than to any heat in the moving air. When a cyclone travels far enough so that the northwest winds reach us, the temperature falls and colder weather results.

Clear, Cloudy and Rainy Weather. These alternate in the state, and why? We remember that in summer time warm, clear weather with wind from the southeast changes to cloudy and then to rainy weather, and that clouds usually disappear soon after each rain.

We should know what causes rain in Nebraska. Air moving northward from the Gulf of Mexico carries much moisture to Nebraska and the other states. This warm and somewhat moist air enters the southeast quadrant of a cyclone. It rises in the low pressure region and overflows eastward. The moisture of the ascending air is condensed first into clouds, and then into mist and raindrops. The water vapor condensing and overflowing to the east of a low pressure region causes the rain to fall on that side. A given place in Nebraska experiences different kinds of weather in about the following order, due each time to the passage of a cyclone: (1) clear weather; (2) increasing cloudiness; (3) rain or snow; (4) clearing weather.

Storms. The state is visited at times by storms, some of them destructive, while others exist more in name than in reality, all occurring in some part of a cyclone and usually in the southeast quadrant. The thunder storm accompanied by more or less lightning is the best known example. It occurs either to the east or southeast of a low pressure area. Most storm clouds seem to "come up" from the west or northwest; they quickly cover the sky, causing darkness at times, and if the wind is strong, may cause alarm, though there seldom is any real danger. Lightning does some damage but no more here than in adjacent states. The so-called "cloudburst" of western Nebraska is a thunder shower in which there is a heavy rainfall over a small area within a short time. Hail storms appear in all parts of the state, but apparently most frequently in the western parts. The results of hail storms are well known, by their destroying crops, breaking window glass and even killing small animals. As a result of such damage many farmers now carry hail insurance on crops subject to this risk. Fortunately the path of such a storm is narrow and the damage small when the whole state is considered.

Dust storms, of which much has been written, occur most often in March and April. They are disagreeable, but seldom destructive. The sky may cloud over as indicating rain, though usually little or no rain falls. If rain forms high in the air at such times it is re-evaporated before reaching the ground. Dust storms do not occur often in Nebraska; spring and summer may pass without a single typical example.

The tornado, though quite common in certain parts of the Mississippi Valley, does not often visit our state. The storm cave, or "cyclone cellar" is seldom seen.

The term "blizzard" is falling into disuse in weather reports. A few years ago the term denoted the following conditions: (1) low temperature; (2) strong wind; (3) falling snow. Many citizens improperly call every flurry of snow a blizzard.

Weather Forecasting. From a study of observations telegraphed to Washington and to many stations of the Weather Bureau, the weather that may occur within a day or two is forecasted.[1] The principal factor in forecasting is the cyclone. If a storm center, or area of low pressure, occurs in eastern Wyoming at a given time, it is apt to move as far east as southeastern Nebraska within twenty-four hours and to the northeastern part of the United States within a day or two more. Since the conditions of the cyclone are known, i.e., its rate and direction of motion, wind, rain, snowfall, etc., there is reasonable assurance that the weather will occur for the succeeding hours as predicted. A storm center may pass farther south or north in its route than expected. Also, it may move faster or slower than usual. Then the results will vary from those forecasted. If cyclones followed routes as definitely as do railway trains and if their velocities could be as well regulated, many more forecasts would be true. As it is, about 83 per cent of the predictions published in our state prove correct.

Forecasting is made with some degree of assurance for one or two days ahead, but not for longer periods. The predictions published in almanacs are without value. We know that it is apt to snow somewhere in our state on almost any winter day and rain somewhere on each spring or summer day. On this account there is wide latitude for a correct guess that it will snow or rain at about a certain time, but in these mere guesses there is little value. In order to prepare for its coming, we should know the time a snowstorm, cold wave, or a rain storm will reach a given place. This cannot be foretold by "long range forecasting."

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[1] Moore, Willis L., National Geographic Magazine, June, 1905, pp. 255-305. "This is a very concise and valuable article. The home of the National Geographic Magazine and Society is in Hubbard Memorial Hall, Washington, D. C."

Weather Maps. These are published and distributed daily by the Weather Bureau to postoffices, schools, railway offices, hotels, and citizens wishing them.[1] They are prepared at all of the principal stations of the Weather Bureau and issued at the same time from these various places. Maps give the weather conditions at 7 a.m. central time of the day issued, in all parts of the United States, and forecast the probable weather for twenty-four hours or more ahead. Such maps are valuable aids to a study of the weather and climate and are now used in many schools.

The maps have their greatest value in a state like Nebraska where weather changes are sudden and at times extreme.

QUESTIONS AND EXERCISES

1. Why do people talk so much about the weather?
2. What is meant by weather elements?
3. How can you prove the air is substance and that it has pressure and weight?
4. What is saturated air?
5. Compare clouds of summer, winter and spring.
6. Would a bucket do for a rain gage? If not, why?
7. What is the mean annual rainfall where you live?
8. Why do we say that the amount of rainfall is a geographic influence?
9. What is meant by a "low barometer"?
10. Can you, without a barometer, tell when the air is heavy or light?
11. How can you tell in what part of a cyclone you are as it passes over you?

[1] The maps may be obtained by addressing a request for them to Section Director, Weather Bureau, The University of Nebraska, Lincoln, Nebraska. The Climatic Charts are obtained from the Department of Agriculture, Washington. These maps and charts may be used as a basis for laboratory studies.

12. With what winds do the snows at your place generally come?

13. Why is air in the southeast quadrant of a cyclone warmer than that of the northwest quadrant?

14. What is long range forecasting and why is it unreliable?

15. What causes rain in Nebraska and from where does it come?

16. How does hot, dry air injure crops?

17. Does very dry air have any beneficial effects?

18. During which months do crops grow most and why?

19. Observe and describe a snow storm, a hail storm, or a rain storm.

20. How is cloudy weather shown on a weather map? Rain? Temperature? Air pressure? Direction of wind? How can you tell where a cyclone is located?

21. Why should every citizen of Nebraska know how to read a weather map?

CHAPTER V

CLIMATE OF NEBRASKA

In this chapter we are to learn about the average weather or the climate of our state. Climate is the sum total of weather for the day, month or the year as experienced during long periods of time. Its elements are about the same as those of weather.

Temperature. Nebraska often experiences sudden changes in temperature. The range between day and night also is quite marked. The average coldest part of the day is just before sunrise, and the warmest between three and five o'clock in the afternoon. Further, there is a wide range between summer and winter, January being the coldest month, and July the warmest. Occasionally during the coldest days of winter the thermometer registers 25 degrees below zero, while in a few exceptionally cold periods it has reached 40 degrees below zero. In the hottest days of summer the thermometer at times registers 100 degrees or more above zero in the shade.

The average annual temperature is highest in the southeastern part, decreasing to the north and west or with the latitude and altitude. The following outline shows the average temperature in four parts of the state for January, July and the year.

	Jan.	July	Yearly Average
In the northeastern part (above zero)	19°	72°	46°
" " northwestern " " "	19	72+	46+
" " southwestern " " "	23	76	50
" " southeastern " " "	25	78	52

These temperatures do not indicate very cold winters or unusually warm summers.

Since the northwestern region is the higher it would also be colder than the northeastern if the Chinook wind did not pass over it. The northeastern part of the state is as cold as the northwestern part, perhaps somewhat colder.

Nebraska has a long growing season and a long harvest season free from frosts. The air is dry and the ordinary freeze does little damage to crops. This is especially true in the western counties. The average number of days from the last frost of spring to the first frost of autumn decreases to the northwest. The number in the southeast varies from 155 to 165 days, while in the northwestern counties it decreases to from 130 to 135 days.

Humidity. The air of Nebraska when compared with that of states in the same latitude, but farther east, is rather dry. The relative humidity decreases from east to west, with the rainfall. The absolute humidity or the entire amount of moisture in the air is greatest from about 3 to 4 o'clock in the afternoon, while the highest relative humidity is in the early morning. There is more moisture in western Nebraska, in summer time than is thought. True, the relative humidity is usually low at that time, but the absolute humidity is about as high as it is in the eastern counties. Water vapor is in the air, but the conditions are not favorable for its precipitation.

Sunshine and Cloudiness. The state, especially in the western part, has an abundance of sunshine. The cloudiness increases eastward, the cloudiest part of the day being the afternoon, while the nights, on an average, are clearer than the days. There are few fogs, and from the standpoint of sunshine and cloudiness the air is most healthful. Persons with lung trouble often move into the western counties with favorable results. In summer, dry air is not so oppressive as

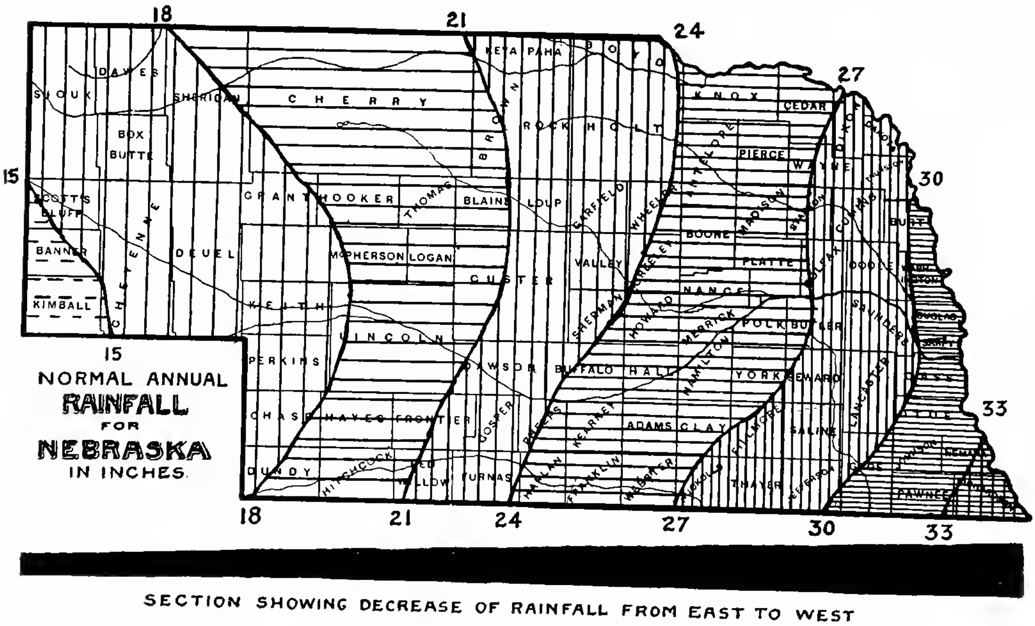

Fig. 10. Map and Section showing Distribution of Rainfall

warm, humid air; on that account the high heat of western Nebraska is noticed less than one would expect. The conditions here in summer are quite in contrast to the sultry atmosphere of some of the southern states.

Winds. The exact wind velocity is not known. A gauging station at Omaha gives an average for ten years of eight miles an hour. Another at North Platte shows an average of nine miles. This would give a mean for the two stations of eight and one half miles, which seems to be lower than the normal average of the state. The wind is stronger in the western counties than in the east. It is strongest about noon and lowest between midnight and the early morning. The highest monthly wind velocity is in March and April and the lowest in July and August. From October to the first of May, the prevailing direction is from the north and northwest, while in May and September it varies from northwest to southeast. From June to August and during a part of September the direction usually is from the south and southeast. Though the wind of Nebraska may be somewhat stronger than that of Iowa and Illinois, it is not so erratic as we sometimes are led to believe. It is utilized throughout the state to drive thousands of windmills that pump water. The nearly constant breezes of summer render the high temperatures less oppressive than they otherwise would be, as the body is cooled by rapid evaporation of its perspiration. At the same time winds cause excessive evaporation and loss of moisture from free water surfaces and from the soil.

The Rainfall. Records of rainfall have been kept for about fifty years, of which time the reports of the last thirty years are most reliable[1]. The gauging stations are distributed generally throughout the state and on that account the average of the records must be nearly correct. We now know that the precipitation in Nebraska occurs mainly in connection with thunder storms which move across the country with the cyclones, usually coming late in the day, about 7 p.m. The average rainiest part of the day in summer is from 5 to 10 p.m. The western counties have an annual rainfall of 15 to 20 inches and the southeastern counties about 30 inches, this being greatest in the southeastern counties and decreasing gradually to the north and west, as is shown by figure 10. The average annual rainfall for the state as a whole seems to be about 23⅓ inches. This unequal distribution of rainfall very noticeably influences the distribution of plants and animals, and also has a strong control over the agricultural development of the state as is shown in the following chapters.

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[1] Swezey and Loveland, Bull. 45, Experiment Station, University of Nebraska, Lincoln, Nebraska.

FIG. 11. TYPICAL SNOW SCENE IN NEBRASKA

The snowfall, which is about one-twelfth of the total rainfall, averages 20 inches per year, making nearly two inches of water when melted. The fall is greatest in the northeastern counties, decreasing to the south and west. Most of the snow comes in January and February, and as a rule lies on the ground for a short time only, (Figure 11) making sleighing very uncertain.

Rainfall by Months. The precipitation increases in amount from early springtime to June, during which month it is the heaviest, then decreases gradually until December. The average rainfall of June is over five inches in the southeastern part of the state and slightly less than three inches in the extreme western part.

The following outline shows the mean annual rainfall for the state by months for the past thirty years:

	Inches
January	0.68
February	0.71
March	1.16
April	2.40
May	3.60
June	3.93
July	3.51
August	2.62
September	1.84
October	1.49
November	0.68
December	0.69
TOTAL AMOUNT	23.31

These figures show that fortunately most of the precipitation in Nebraska occurs during the growing season. Perhaps a better way to state it is to say that the crops grow most rapidly in the increasing warmth of spring and summer, when they also have the most abundant rains. Records at the Weather Bureau stations show that about 69 per cent of the state's rainfall comes within the five months beginning with April and ending with August. In this respect Nebraska, Kansas and the Dakotas are more favorably situated than are states farther east because here the moisture comes when it is most needed. Yet we should not forget that evaporation from a free water surface is greater here than it is farther east. Another noticeable condition is that the rainfall decreases at harvest time; while the decrease is slight at the time the small grains are harvested, it is more apparent when the latest crops of alfalfa are cut and corn is gathered.

Number of Rainy Days. In this connection another feature of Nebraska climate may be observed, namely, that the rainfall, though somewhat light, comes in moderate showers and that there is an average of ninety-one rainy days during the year. In any one locality in Nebraska there is an average of one rainy day in four. The value of the rainfall is about one-fourth inch for each rainy day; rarely does the daily rainfall exceed one inch.

The following outline, from Bulletin 45 of the Nebraska Experiment Station, shows the average number of rainy days in each month of the year, including the snow fall:

January	6.3
February	5.7
March	6.5
April	9.2
May	12.1
June	10.2
July	9.9
August	8.5
September	6.6
October	6.0
November	4.1
December	6.0
Total	91.1

The average amount of rainfall for a rainy day in January is 0.11 inches; in April 0.26; in July 0.35; and in October 0.25.

Fluctuations in Rainfall. Experience shows that the rainfall of a given month or year is apt to vary from the average. The variability for a number of places in Nebraska has been calculated for periods of twenty years or more. The average annual rainfall of June is 3.93 for the state, yet this is expected to vary 1.11 inches or 25 per cent and often more. The amount of rainfall for a given month or year in Nebraska is not, therefore, an absolute certainty, the greatest uncertainty occurring during the months of low rainfall. There also is a strong probability of a deficiency in the growing seasons, especially in July.

Fluctuations for any one place are apt to be greater than for the state as a whole. The variations seem more marked in the western counties than in the east and southeast, yet this seeming difference may not be well founded. Everyone knows the effects of a season of deficient rainfall or drouth. These dry times occur over the whole of the Great Plains region and the results are well known in every state.

Cycles of Rainfall. A study of precipitation has shown that the state has had alternating periods of wet and dry years.

In each case the increase and decrease has been gradual. These groups of years seem to have followed one another with some regularity. Periods of low rainfall have produced semi-arid or drouth conditions in the western counties while at other times a gradual increase in rainfall has brought about humid conditions. The western part of the state has suffered much from fluctuations in rainfall, while the eastern counties and bordering states have not entirely escaped the unfavorable results. The extremes in wet and dry periods seem to have come at intervals of from eight to ten years.

Increasing or Decreasing Rainfall. The precipitation records for about fifty years show variations, but no permanent change. The rainfall from 1850 to 1870 seems to have averaged 23.55 inches a year, while that of the next twenty-three years was 23.46 inches a year. It is now believed that cultivation of soil does not cause an increase of rainfall, as so many have supposed. Though the precipitation is not varying permanently for the better, farmers are learning gradually how to adapt their crops and cultivation to the conditions as they actually exist.

If we had lived during the long periods of time when the rock beds of Nebraska were forming, several changes in rainfall might have been observed. If the rainfall is increasing or decreasing now, the permanent change is so slow that it will hardly be noticed within a century.

Nebraska Evenings. To one born and reared in an eastern or a southern state in which the humidity is high, Nebraska's summer evenings are a source of great enjoyment. Usually they are clear and invigorating with perhaps clouds enough in the west to produce a beautiful sunset. The wind is lower than at noon day. But the change in temperature seems most enjoyable, being a relief from the heat of the day. It is neither too hot nor too cold, but generally is about right for the full enjoyment of walking, horseback riding, driving, or any preferred recreation. As the night comes on the temperature falls slowly, becoming quite cool, especially in the western counties.

Healthfulness of Climate. Nebraska has an abundance of sunshine and an air somewhat dryer than that of most states. These conditions as they occur here may be called favorable elements. The quick changes in weather are for the most part unfavorable, and the same may be said, but to a less degree, of the rather marked diurnal and annual ranges in temperature.

As a whole, Nebraska is known as a healthful state in which to live; but its low death rate and good name are not due to the climate alone. We have yet to learn of the drainage and the water supply.

QUESTIONS AND EXERCISES

1. How do the terms "weather" and "climate" differ in meaning?

2. Why is not the warmest time of the day at noon?

3. Why does the mean annual temperature decrease northward and westward across Nebraska?

4. What are some of the unfavorable results of high temperature? Of low temperature? Of large range in temperature?

5. Why are there fewer sleighs in Nebraska than in Iowa?

6. Why does most snow in Nebraska fall in January and February?

7. Why do the heaviest rainfall and the growing season come at about the same time in our state?

8. Why do people think the rainfall is increasing? In what ways would an increase of rainfall improve the state? How injure?

9. Which affect agriculture most — hailstorms, cold waves, or low rainfall?

10. What conditions of Nebraska climate do you regard as healthful? Unhealthful?

CHAPTER VI

GROUND-WATER AND DRAINAGE

In preceding chapters we read about the state's structure and rainfall, both of which have something to do with the ground-water. In this chapter we shall find out what becomes of the rainfall. Since it does not remain on the ground after falling as rain, snow or hail, we should like to learn more of what becomes of it. We know that snow and hail melt, forming water. The water on the ground seems to disappear in three ways—some evaporates, part soaks into the ground, and the rest of it runs off, forming streams.

Water in streams, ponds and lakes is called surface water by some writers.

The evaporated water raises the humidity of the air and may again become rainfall.

Surface Storage. In some states much of the rainfall is caught and held for a time in lakes. Minnesota is a good example of a state with many lakes containing a large amount of water, some of which drains out into rivers. In Nebraska, a small part of the rainfall finds its way into lakes and ponds, but most of these dry up during the summer, the water being lost by evaporation and by percolation or sinking into the ground.

Ground-Water. A large amount of Nebraska's rainfall soaks into the open textured soils; becoming ground water.[1]

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[1] Professional Paper No. 32, by N. H. Darton; Water Supply Paper No. 70, by G. I. Adams; The Geology and Water Resources of Northeastern Nebraska, (in press) by G. E. Condra; The Geology and Water Resources of Southwestern Nebraska (in press), by G. E. Condra, are the general references on Nebraska published by the United States Geological Survey.

The sandy soils are capable of taking in a heavy rain, while finer-grained soils absorb a smaller amount of each rain, especially when the fall is fast and heavy, but they have the capacity to receive and hold much water.

Each rain moistens the ground at the surface. A part of the moisture thus caught is used by growing crops; part comes to the surface as capillary water and enters the air by evaporation while the rest percolates to lower levels in the ground. Everywhere in our state, at some distance below the surface of the soil, the little spaces in the ground are completely filled with water. In other words, the ground, deep down, is saturated with water, forming the saturated zone. The upper surface of the saturated zone is called the water table. It rises in the ground during rainy periods and falls during dry times. In some places it is close to the surface; at other places it is one hundred and even three hundred feet below. The space between the water table and the surface of the ground is called the capillary zone. Water of this zone comes either from rains by percolation or from the saturated zone by capillary action.

Amount of Ground-Water. We cannot tell just how much water there is underground. The amount is large, representing a part of each rain for many years. Sands and gravels when completely saturated hold from 25 to 30 per cent of their volume of water. If all of the water contained in the soil and underlying rock beds of Nebraska could be placed on the surface of the ground, it would make a sea deeper than Lake Superior.

Underground Drainage. The water in this vast underground reservoir is slowly moving.* The rate of motion is not as rapid as that of surface streams; in fact it is too slow for us to say that it flows. However, there is motion or drainage through the ground from the high places to the low places, i. e., from the high uplands to the valleys and lower places. (Figure 12) Water moves through gravels and sands faster than through clays and other fine-grained rocks. Pervious beds, such as gravel and sand, permit water to pass through them quite freely. The fine-grained rocks, do not permit rapid percolation, so they are said to be impervious. This underground drainage, though important, is not confined to channels, as is the surface flow. Its valley is all of the little openings between the particles of soil and the bed rock.

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*Slichter, C. S. The Motions of Underground Water, Second Ed. (in press). United States Geological Survey.

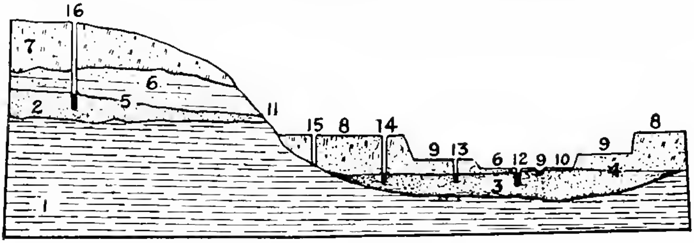

FIG. 12. AN IDEAL SECTION OF A VALLEY SHOWING WATER CONDITIONS

No. 1, Impervious beds; 2, Saturated ground in upland; 3, Saturated Alluvium; 4 and 5, Water table; 6, Upland sands and Alluvium above water table; 7, Loess; 8 and 9, Terraces; 10, Flood plain; 11, A spring; 12, Shallow flood plain wells; 13, Lower Terrace or bench well; 14, High bench well; 15, Dry well; 16, Deep upland well

Importance and Use of Ground-Water. In some respects the ground-water is even more important than the rainfall from which it comes. It is much more important than the surface water. Ground-water has several uses of which we will name only the principal ones. Crops receive their supply of moisture chiefly from the ground. The capillary water is taken up by plant roots. The springs, the shallow wells and the artesian wells are all fed from ground-water.

Springs. These have their source and supply in the ground-water which flows out of saturated rock beds.

There are thousands of springs in Nebraska, some being quite strong. The water in the ponds at the State Fish Hatcheries near South Bend (Figure 13) is supplied by springs, coming out of sandstone in a deep ravine. The water is carried from its source by pipes extending to the various ponds in which are kept the different kinds of fish. Many large ranches in Nebraska obtain their entire supply of drinking water and stock water from springs.

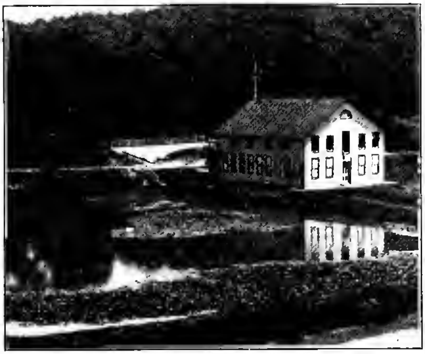

FIG. 13. SPRING-FED PONDS AT THE STATE FISH HATCHERIES NEAR SOUTH BEND
Photo by E. H. Barbour

Origin and Occurrence of Springs. They are found principally along valleys where pervious beds outcrop over clayey or impervious strata. The impervious beds check the downward course of the ground-water, causing it to level up in the ground, when some of it spills out or escapes into the valleys as springs. The water of most springs comes out of sandy layers above clayey beds. At places the springs are close together, being found in nearly every ravine. Especially is this the case wherever the Pierre shale is exposed below sandy soil. The valley then is somewhat like a great well into which the ground-water moves from saturated pervious beds. If the valleys were less deep, there would be fewer springs in our state.

At a few places the water boils or bubbles up intermittently from circular or subcircular openings in sand. One of the best examples of this kind is found near the Dismal River in Thomas County. (Figure 14) This spring is seven or eight feet across, flowing a large volume of water. The ground around the spring vibrates or shakes as the water escapes. The "Mound Springs" of Johnson county are a form of boiling spring, in which the water rises from the center of circular mounds, hence the name. In the vicinity of Sterling they are called "Kettle Springs."

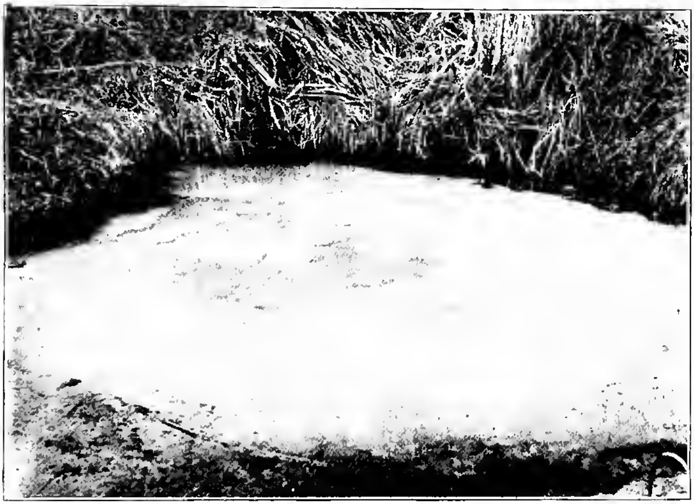

FIG. 14. A LARGE BOILING SPRING IN THOMAS COUNTY

Well Water. We refer here to the ordinary well water of the farm or town. A well is a dug, bored, drilled or driven excavation extending down to the saturated zone of ground-water. This ground-water flows out of the sand or gravel in which the well usually ends, filling the well to a level as high as the water table. Wells vary in depth because the saturated zone of ground-water is not everywhere the same distance from the surface of the ground. On this account valley wells usually are shallow while those on the uplands are deep. Well water is ground-water obtained through an artificial opening in the ground. The depth of the water in a well depends upon the distance the well extends below the water table.

The depths of wells and the quality and quantity of their water are the most important factors for us to consider as we study the different parts of the state.

Strong and Weak Wells. Our state has many strong wells, some in which the water can hardly be lowered by pumping. In such cases the water moves into the well out of coarse sands or gravels which permit it to flow in quite rapidly. Most weak wells receive their water from fine sand, through which water moves slowly.

Dry wells have little or no water in them, as they do not reach a place in the ground which is saturated. (Figure 9)

Quality of Well Water. The quality of water accessible for drinking purposes is an important consideration for people who settle and develop a country. Nebraska as a whole has an abundant supply of good well water, yet there are a few places where it is difficult to secure good drinking water, the supply being either alkaline or saline. The differences are due to the fact that ground-water dissolves materials from the different formations through which it moves. Wells ending in either Pierre shale or in the Niobrara chalk rock give a poor quality of water, while that obtained from the Dakota sandstone is medium hard and at a few places saline. The upland sands of central and western Nebraska contain soft to medium hard water.

An inferior and often dangerous supply of water results from poor care of wells. Water percolating through the ground to the well gathers up organic impurities; on this account we should not use water from wells located too near stables and other sources of pollution. Dug wells should be cleaned often in order to insure a supply of water as pure as possible, thus guarding against disease.

Artesian Wells. These are not easily defined. Nearly all of them are drilled, not bored or dug. They are small in diameter, but usually deep, and the water comes into the wells with pressure. (Figure 15) In some cases the pressure is very strong, causing the water to flow from the well with great force; in others the water rises only a few feet in the casing.

Since artesian wells have considerable importance in Nebraska, we should study the conditions under which they are obtained, and their distribution and uses.

Conditions Giving Artesian Wells. It has been shown that rock beds occur below the soil and that they are in a nearly horizontal position. These strata extend out into South Dakota, Wyoming and Colorado, coming to the surface at places in the mountains. (Figure 3) Wherever the pervious beds are exposed in the mountains or elevated places they take in much of the rainfall. The water, thus caught, chiefly in sandstones, moves slowly through them to the lower altitudes in Nebraska. Clay beds lying above the sandstones prevent the artesian water from escaping to the surface, so the water held in position while passing from higher to lower places is caused to move under pressure. All that is necessary to secure the artesian flow from the imprisoned water is to drill and carefully case a hole to the water, when, if the pressure is strong enough, it forces upward to and above the surface of the ground, forming an artesian well. Most students know

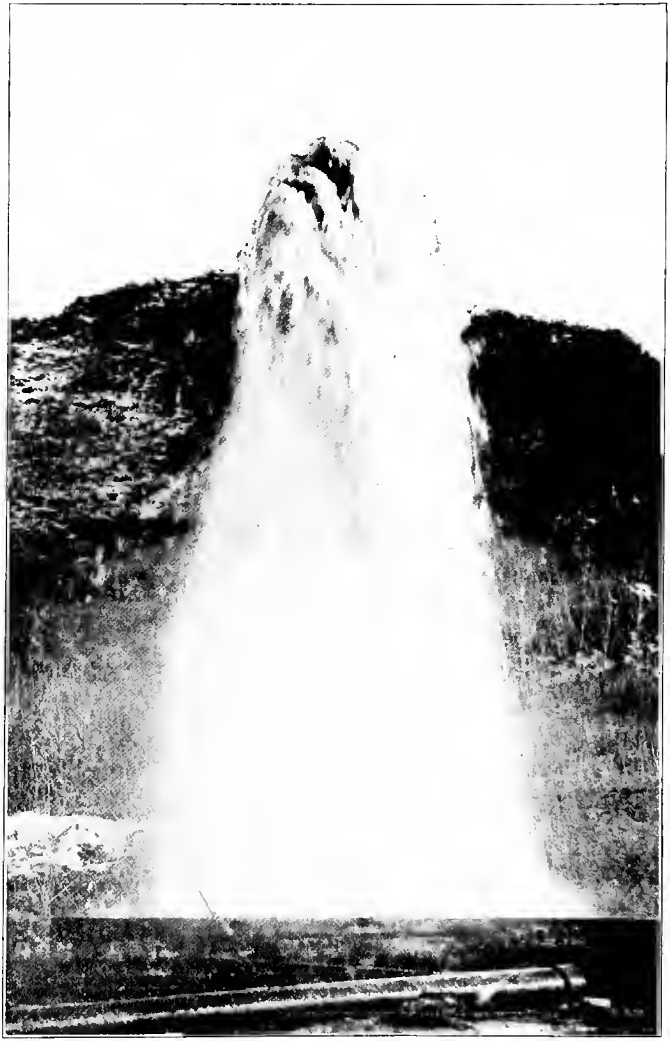

FIG. 15. THE DEEP ARTESIAN WELL AT LYNCH, NEBRASKA THROWING WATER 20 FEET IN THE AIR BEFORE IT WAS USED FOR MILL POWER.

how water is supplied from a high standpipe to different parts of a town or city and why it comes from faucets with force when allowed to escape. In some ways the water of an artesian basin resembles that of the water works; the water is held in place by impervious clay beds and thus caused to move through the pervious strata instead of through pipes.

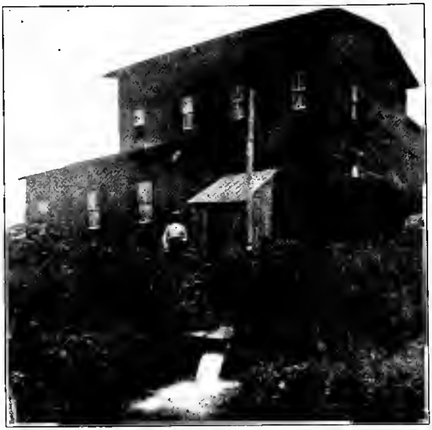

FIG. 16. THE NIOBRARA FLOURING MILL OPERATED BY WATER FROM AN ARTESIAN WELL, THE OVERFLOW OF WHICH SHOWS IN THE FOREGROUND

Distribution and Use of Artesian Wells. Many artesian wells occur along the Missouri from Boyd to Dixon counties. Passing from west to east they vary in depth from 923 to 177 feet. There are more than one hundred artesian wells in Cedar County alone, affording water for domestic purposes, stock, irrigation, fire protection and power. At Niobrara, Knox County, a flouring mill with a capacity of sixty barrels a day is run by the power or force of one well which flows over 2,000 gallons a minute. (Figure 16) The water coming from the well is directed through a nozzle and against a small Pelton wheel from which power is transmitted to the machinery of the mill. A still larger well at Lynch, Boyd County, (Figure 15) is 923 feet deep and 10 inches in diameter, flowing over 3,000 gallons a minute. This well is now used as a source of power for a flouring mill and for electric lighting; it also furnishes part of the water for the town.

The porous rock from which comes the artesian water of northeastern Nebraska, is the Dakota sandstone; farther east in the state this rock outcrops along the Missouri River and other streams, its water escaping as springs. In Holt County and in several other sections of the state there are small, shallow artesian basins, the Beaver Crossing and Alexandria basins being best known.

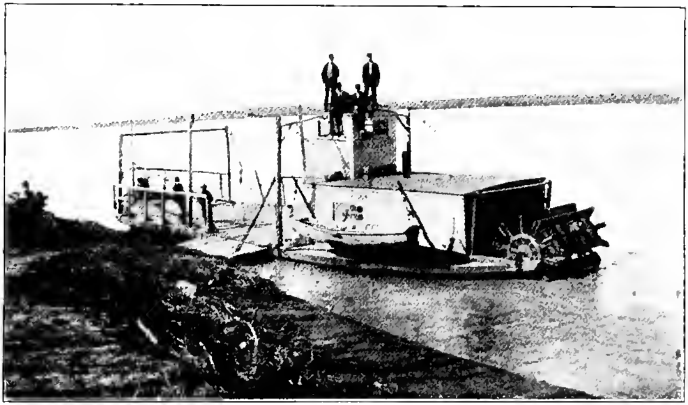

FIG. 17. THE PONCA FERRY BOAT. IT IS USED TO CARRY TEAMS AND PASSENGERS ACROSS THE MISSOURI RIVER.

An artesian well two miles west of Lincoln is nearly half a mile deep, extending to Carboniferous and yet older beds. Wells similar to this, though not so deep, are at Omaha, Beatrice, Deerfield, and other places in the eastern counties.

The Run-off Water. This is the part of the rainfall which feeds the streams. We do not know just how much of the state's rainfall soaks into the ground and how much runs off, but we do know that there are places where the run-off is very small. It has been estimated that 90 per cent of the rainfall soaks in forming ground-water and that 10 per cent of it runs off. Such a statement, though, is little more than a guess. Yet when compared with eastern states the run-off in Nebraska is light in comparison with the soak-in.

At flood time some rivers become large and even overflow their banks, yet as a whole the surface drainage and surface water are less important in Nebraska than we sometimes think.

Streams are fed also by springs which may be called the indirect run-off, their water coming from underground. Spring-fed streams are more uniform in their flow than those supplied by surface water only.

Streams and Valleys. The run-off water unites from many tributaries and forms larger streams. All rivers, large and small, begin in about the same way. Portions of Nebraska have no streams and valleys, but at most places the surface of the land is somewhat broken, showing drainage ways and streams, the latter at least for a time after a rain. The land surfaces have not always been smooth or rough as they appear now in localities. The run-off water roughens the upland, especially on steep slopes, and deepens or widens the valleys, as we may learn by observation. Valleys in turn serve as drainage ways for the water, that part of a valley in which the river is located being called the channel of the river. In many places the rivers of Nebraska are roughening the surface, while at a few other places they are building up smooth land. In the first case they are destructive and in the latter constructive agencies.

Drainage Directions. By examining a map of the state we may observe that the longest rivers flow with the surface slope from west to east. This we would expect. But in the eastern part of the state the Platte makes a big bend to the south and the Blue Rivers do not flow eastward. Salt Creek is a noticeable exception, its course being northeastward. The Loup Rivers and the Elkhorn flow in a southeasterly direction for most of their length. We do not know what has caused these rivers to take such positions and directions and to unite in such a peculiar manner as may be noted from the map.

The valleys and rivers of Nebraska extend in two main directions and appear to form two drainage systems—one from west to east and the other from northwest to southeast.

QUESTIONS AND EXERCISES

1. What becomes of the rain which falls on your school ground?

2. What is surface storage? Capillary water? Ground water?

3. How does the rain become ground-water?

4. From what source is ground-water secured for use in your home? Is it pure?

5. Do the wells in your neighborhood differ in depth? If so, why?

6. Compare stream, spring, artesian and shallow well water as to source and purity.

7. Can you illustrate by drawing or by experiment the principle of the spring? Of the artesian well?

8. Why are most of our springs in valleys?

9. Why can't we secure artesian wells on high lands?

10. What is a boiling spring?

11. What is run-off water? When is there the most run-off at a place? Why?

12. By what means is run-off water sometimes checked and stored for future use? Give an example near your home.

13. Do any streams begin on your school ground?

14. As to direction of their drainage, how many systems of valleys has Nebraska? Give examples of each system.

CHAPTER VII

THE PRINCIPAL DRAINAGE BASINS AND RIVERS

The area drained by a river or river system is known as its basin. It is not so important for us to learn the many places where a river heads as it is to study the character of the river itself, noting how it is affected by rainfall and evaporation.[1] We should learn the form and area of each principal drainage basin as well as the appearance of land within it. Some rivers occupy deep, narrow valleys; others are in wide, shallow valleys. Some valley-slopes contain exposed ledges of rock while others are completely covered with grass and trees.

The Missouri River. This, our largest river, is widely known as the "Big Muddy." It meanders over 400 miles along the eastern border of the state. It is wide, deep and swift; but it has a fall of just a little less than one foot per mile.[2] The highest waters come in March and June or with the spring rains and with the run-off from melting snow in the mountains of Montana, Wyoming and Colorado. The Missouri drains very little of Nebraska except through its principal tributaries, the Niobrara, the Platte and the Nemahas. At places the land at the crest of the bluffs slopes away from the river.

The river cuts hard on its right bank at a number of points, producing high bluffs, at the same time leaving most of the bottom land on the opposite side of the stream. The varying appearance of these bluffs along the river is due principally to different kinds of rock outcropping in the valley.

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[1] Stephens, J. C. Hydrography of Nebraska (in press) U. S. G. S. This paper gives the gaugings of the principal rivers.

[2] Study Elk Point, Omaha, Atchison, Kansas City and Jefferson City topographic maps.

The river water, though turbid, is quite pure for drinking purposes when the sediment is removed. Omaha and other cities and towns near the stream obtain their water supply from this source.

Besides its use as drinking and stock water the river has some importance in transportation and in yielding fish. Steamers in the vicinity of Yankton and Sioux City carry fuel, grain and live stock. Small boats known as ferries operate at or near a number of river towns (Figure 17) without bridges. Eight large bridges span the Missouri along the eastern border of Nebraska. During the coldest times of winter the ice of the river is used as a roadway above Sioux City, when heavy loads of wood and grain are hauled by means of teams and sleds.

The Niobrara River. This, the "Running Water," is one of our swift streams. Its volume of water ranges from 500 to 1,000 cubic feet per second at Valentine and from 1,000 to 2,000 second-feet[3] at Niobrara. The river is swift, usually shallow, and little affected by storm water except near its mouth. It is supplied with water from many spring-fed streams issuing from ravines and canyons, one of the best-known of which is Long Pine Canyon. Nearly all of the tributary streams are weak, the Snake, Keya Paha and Verdigris being most important.

The main valley is not large, averaging narrow and about 300 feet deep below the uplands. Since the valley-bottom is narrow it contains little farm land. In the vicinity of Valentine the trunk valley is bounded by steep sides and narrow canyons, so it may be called a young valley.

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[3] The term "second-feet" is used to denote a flow of one cubic foot of water per second. Most rivers are gauged, i. e., their flow is measured.

The river affords water for stock, domestic, and irrigation purposes; it also can be used for water power when needed.

In all there are about fifteen beautiful waterfalls in this drainage basin, the best-known being the Snake River, Schlagle, Stinard, Parry and Arikaree falls.

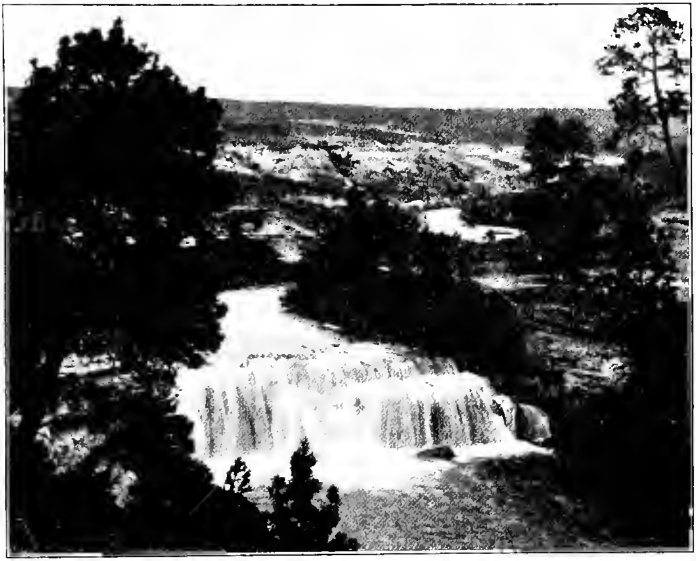

FIG. 18. SNAKE RIVER FALL

Photo by R. A. Emerson

Snake River Falls. The larger fall in this river is located about 25 miles southwest of Valentine, and is not easily reached. (Figure 18) It is the largest in Nebraska. Snake-River at this point is about 60 feet wide, flowing in a narrow, deep canyon and falling some 20 feet over a hard ledge of rock. Farther up stream is another fall said to be even more beautiful than this, though not so large.

Schlagle Fall is in some respects Nebraska's most beautifully situated fall. (Figure 19) It is located in Schlagle Creek, ten or eleven miles south of Valentine. The stream flows in a deep canyon thickly studded with pine trees, and the water is cool, clear, pure, and the home of trout Willows and other smaller tree growths hug the water's edge, while above and beyond the canyons are table-land and sand-hill areas. The water fall is about 25 or 30 feet across and 10 feet high, including a small rapids. This is a favorite outing place for the people of Valentine.

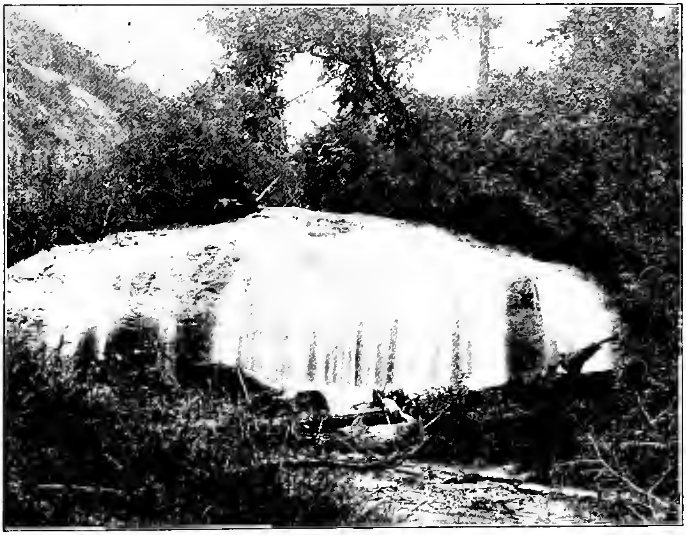

Fig. 19. Schlagle Fall

Photo by E. H. Barbour

Stinard Falls are in a small ravine near the Niobrara river, about six miles below Valentine. The larger fall is nearly 40 feet. The smaller fall is also known as the Bristol Fall.

Sears Falls, large and small, are in a ravine near the Stinard road 9 miles down the valley from Valentine. The larger fall is 12 feet high and is the most beautiful of any in the vicinity.

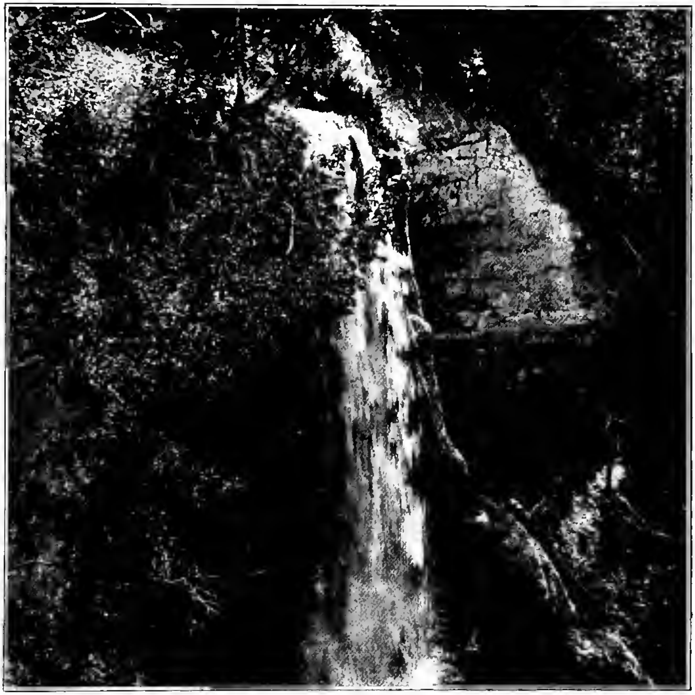

FIG. 20. ARIKAREE FALL, THE FIRST LEAP SHOWING

Photo by E. H. Barbour

Parry Falls are about a mile west of the Berry Bridge and one mile from the Sears Falls. Each, though narrow, is between 80 and 90 feet high. One, quite hidden by thick shrubbery, is by some called the Wonder Fall.

Arikaree Fall is the state's highest and best-known fall. It is in the Niobrara valley 11 miles east of Valentine, where the Niobrara River occupies a canyon-like course and is locally called the Smith fall. In a ravine just above is a small spring-fed stream which tumbles into the valley below as a beautiful ribbon of water. The fall is about 90 feet, consisting of two leaps, the first (Figure 20) being the greater. There are several other falls in this vicinity, though most of them are small, occurring principally in the ravines known as the "Seven Sisters."

In a ravine twelve miles northwest of Wood Lake is the Harvey Fall, which is not easily reached, hence little is known of it.

The Platte River. In some respects this is the most important river of Nebraska[4]. It heads by two branches, but at many places in the Rocky Mountains where it gathers an abundance of water in the springtime. The north branch, (Figure 21), called the North Platte, is the stronger stream; it is used extensively and profitably for irrigation. The Lodge Pole is the longest tributary of the South Platte in our state.

A noticeable feature of the Platte River is that only a few tributaries enter it from the south in Nebraska, Salt Creek being the largest affluent received from that direction. Among the important tributaries on the north are the Loups and the Elkhorn. The amount of water in the Platte River in our state varies greatly with the seasons and with the wet and dry years. During the summers with low rainfall when evaporation is excessive and a limited amount of water is supplied by

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[4] Study Denver, Scotts Bluff, Ogalalla, North Platte, Kearney, Grand Island and Fremont topographic maps.

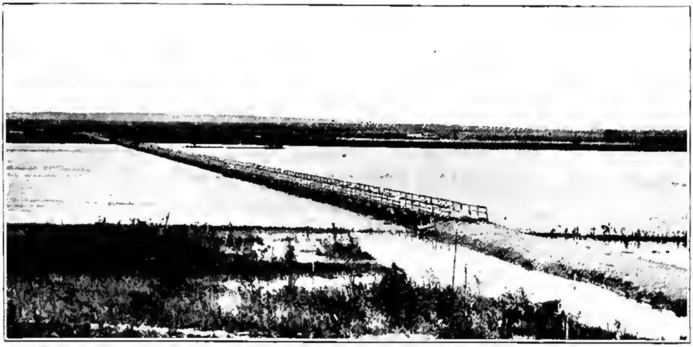

FIG. 21. NORTH PLATTE RIVER AND BRIDGE NEAR GERING, SCOTTS BLUFF COUNTY. THE RIVER OVERFLOWS ITS BOTTOM LAND IN THE SPRINGTIME, BUT DECREASES IN SIZE DURING SUMMER

Photo by H. A. Mark

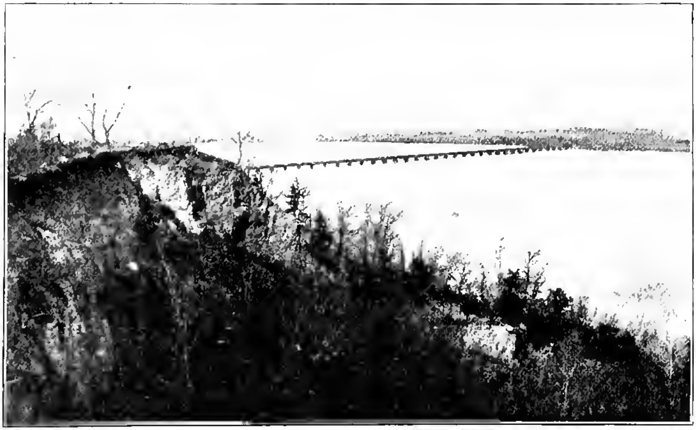

FIG. 22. PLATTE RIVER AND LOESS BLUFFS NEAR FREMONT. SAND BARS COME INTO VIEW AS THE WATER LOWERS. THE NORTHWESTERN RAILROAD BRIDGE SHOWS IN THE DISTANCE

a few weak tributaries, the channel becomes dry throughout much of its length. The only water present then is that which moves slowly just below the surface in the sandy flood plain[5]. The river at flood-time is broad, shallow, and heavily loaded with sand. (Figure 22) In some places it flows as a single channel at low stages, but at other places it spreads out as interlacing streams among sand bars and low sandy islands.

Plate II shows how the Platte Valley varies in width and in other respects at different points. In the western counties it is wide and deep, while across Deuel and Keith counties it narrows somewhat, but expands again in Lincoln County. From this point to Saunders County the river is building up its bed and the valley is less deep, but wide, including rich farming land. From the vicinity of Ashland to the Missouri it narrows and the slopes steepen; here, also, hard rock outcrops in the bordering slopes. The river and valley have a fall of about 3,000 feet while traversing Nebraska. The grade is greatest in the western part of the state where the river is sinking its way in the High Plains Region.

Salt Creek, a tributary from the southwest, takes its name from the saline matter which it receives from certain salt flats, the best known of which are two miles west of Lincoln. Several tributary creeks flow from different directions to the Lincoln basin[6], from which a broad mature trunk valley drains northeastward to the Platte River. The union of so many streams at Lincoln and the northeasterly course of the main valley are the peculiar features of this tributary basin of the Platte. Salt Creek usually overflows its bottom lands at the time of continued heavy rains. This overflow is caused

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[5] Slichter, C. S. The Underflow of the South Platte. (in press) U. S. G. S.

[6] Lincoln and Fremont topographic maps.

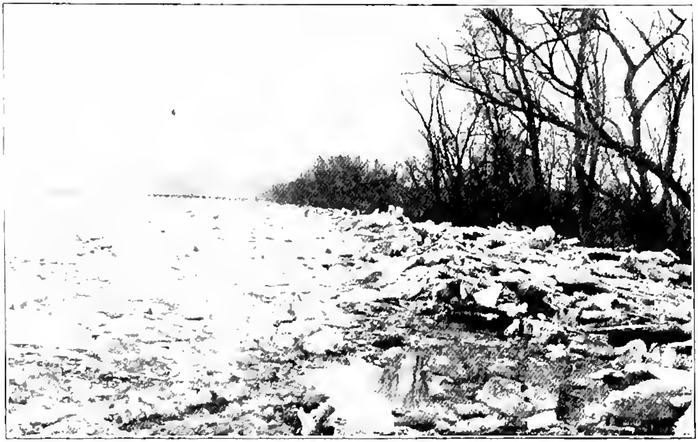

Fig. 23. Ice Gorge in the Platte River at South Bend. The Rock Island Railroad Bridge Shows in the Distance

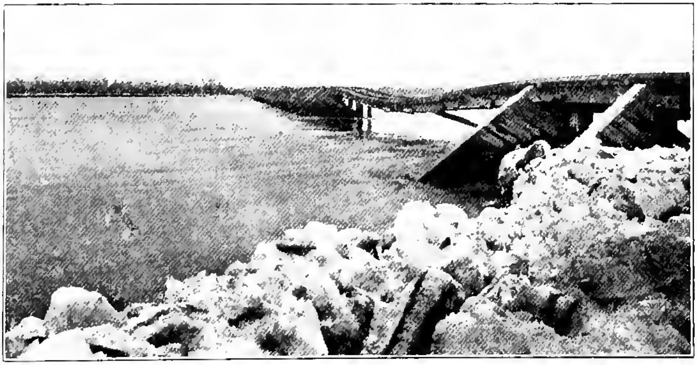

Fig. 24. Railroad Bridge at South Bend Damaged by Ice Gorge

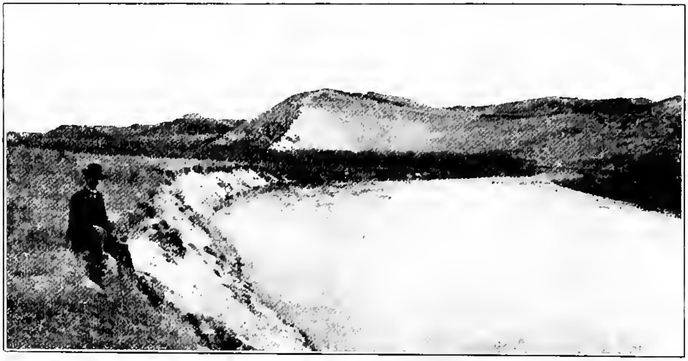

Fig. 25. Middle Loup River between Thedford and Halsey

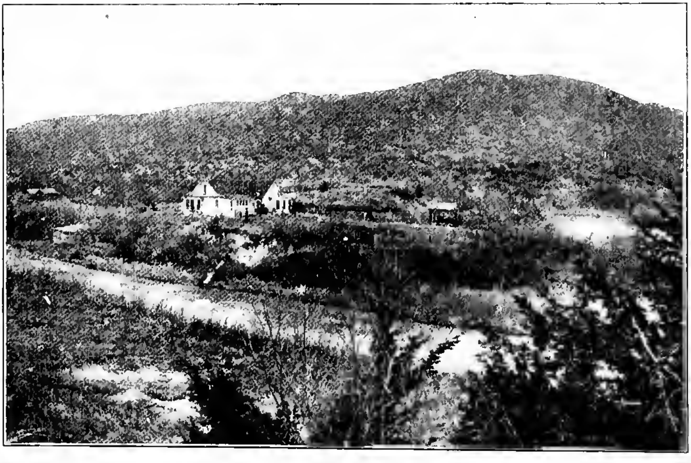

Fig. 26. Dismal River in Thomas County. Ranch Buildings and Sand Hills show in the Back Ground

by its meandering course and by the union of several tributaries in the Lincoln basin.

Ice Gorges. The first warm days of March melt the snow rapidly in the Platte basin. This water enters the river and causes most of the ice to lift, break up, and begin its motion down-stream.

The ice overloads the shallow stream, where sandbars and bridges impede its free run, causing it to gorge at these places. (Figure 23) Sometimes the gorges do great damage to farm property and interfere with railway traffic. (Figure 24) Few railroad or wagon road bridges of the Platte have escaped damage by the ice gorges.

The Loup System. The streams of this group were named from a tribe of Indians. The system is composed of the South, Middle, (Figure 25) and North Loup rivers, and Clear and Beaver creeks. They head in the Sand Hill Region and flow nearly parallel in a southeasterly direction to the Platte River, but all unite before joining the latter. The cause of the rivers' uniting in this particular manner is not definitely known. It seems that at one time they entered the Platte separately and that they united or looped together later. They are fed by many springs in the sand hills, hence change little in size during dry and wet seasons. Dismal River (Figure 26), a branch of the Middle Loup, has few tributaries, its water coming almost entirely from springs. It is a stream which rises and falls only a few inches during a century in its sand-hill course. It carries a heavy load of silt and sand near its head waters but runs clearer farther down stream. The valley widens and becomes marshy above Dunning.

The Loup rivers afford much water for stock and the supply also is used for domestic purposes, irrigation and

Fig. 27. Y. M. C. A. Camp near Milford. Photo by A. J. Coats

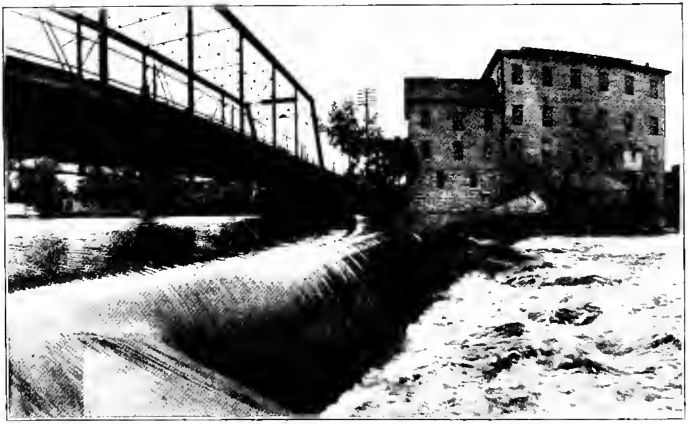

Fig. 28. Water Power and Mill at Beatrice

power. At places, notably above Columbus, ice of the Loups gorges badly, damaging bridges and other property.

There are two large falls in Dismal River, south of Mullen, one in the North and the other in the South Fork, easily reached by railroad and team. A larger but less accessible fall is located in the North Loup River in Cherry County.

The total area of the Loup basins above Columbus is 13,542 square miles and the volume of water poured into the Platte averages 2,000 to 4,000 second feet. It runs as low as 1,300 and as high as 10,000 second feet. Usually the valleys of these rivers are wide, with gradual slopes in which rock beds are exposed at few places[7].

The Elkhorn River. A glance at a map of Nebraska will show the significance of the name of this, the "Horned Deer river," the main branch of which heads among the sand hills in Rock County. From Holt County to the Platte there is less sand. The Logan and other tributaries in the northern part of the basin gather water from an extensive area extending close to the Missouri River.

In most respects the Elkhorn River resembles the Loups, yet it has a greater tendency to overflow. It changes its course readily, forming cut-off lakes. The shallow channel is in a broad flood plain bordered by gradual valley slopes.[8] The river is swift and clear, except at flood time, when it carries a heavy load of sediment. The area of the basin above Arlington is about 5,980 square miles. The amount of water poured into the Platte by this river ranges from 1,000 to 2,000 second feet ordinarily, though at times it runs as low as 400 or as high as 4,000 second feet.

The river water is used for stock, power, domestic purposes,

[7] David City, Stromsburg, St. Paul and Loup topographic maps.

[8] Fremont topographic map.

and in a limited way for irrigation. The stream contains a good many fish.

The Blue Rivers. These are the Big Blue and the Little Blue.[9] They are among Nebraska's most beautiful streams. They are supplied both by spring and run-off water. Some of their smaller tributaries head very near to the Platte.

The valleys contain much fertile bottom land which at places is quite sandy and easily eroded and flooded.

There are many attractive places along the Blue rivers which are visited in summer by camping parties. (Figure 27) The fall of these streams is used for power more than that of the other rivers of Nebraska. (Figure 28)

The Republican River. This river heads in the High Plains of Colorado, hence is without a mountain course. It enters Nebraska by two forks and is joined by both north and south tributaries along a course of about 250 miles in this state before turning southward into Kansas. The principal tributaries are the South Fork, Frenchman, Medicine, Sappa and the Prairie Dog. These are weak streams for the length and size of their valleys. The longest tributaries on the north head close to the Platte.

The Republican River is shallow and relatively wide. Its bed is sandy, bordered by low, sandy banks in a valley bottom ranging from one to three miles in width.[10] At places sand bars and low, sandy islands occur in the channel. The valley slopes contain sand, Loess, sandstone, Pierre, and Niobrara chalk rock, but usually not all at one place. The stream is fed by springs (Figure 29) and storm water. In summer much of the flow is lost by evaporation, and during that time the river becomes dry in places. This condition is most apt to prevail above the spring-fed tributaries in the western counties.

[9] David City and Hebron topographic maps

[10] Arapahoe, Red Cloud, and Superior topographic maps.

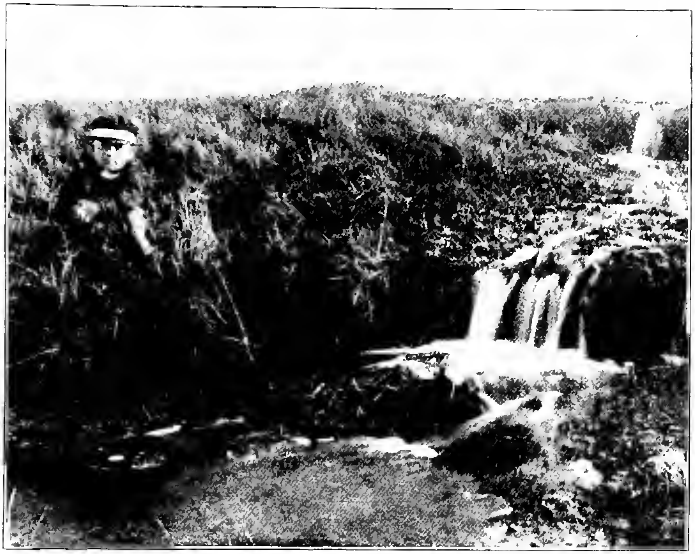

FIG. 29. ONE SOURCE OF THE REPUBLICAN RIVER. IT IS A SPRING AT THE EDGE OF THE SAND HILLS IN DUNDY COUNTY

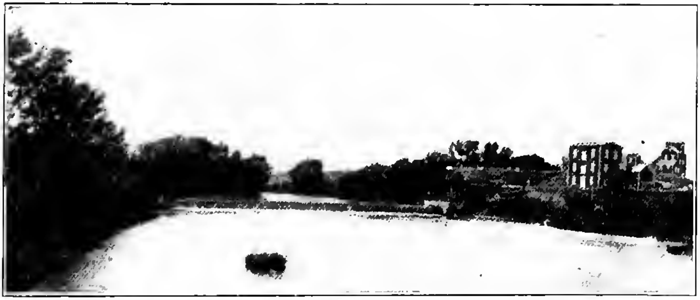

FIG. 30. REPUBLICAN RIVER AT ORLEANS. A DAM AND A FLOURING MILL SHOW IN THE DISTANCE

The river rarely ceases to flow in the vicinity of Red Cloud and Superior.

The area of this basin above Superior is about 22,347 square miles. The gaging at Superior usually is 500 to 1,000 second feet, though it may decrease to less than 100 at low water stages and rise to 10,000 second feet at flood times.

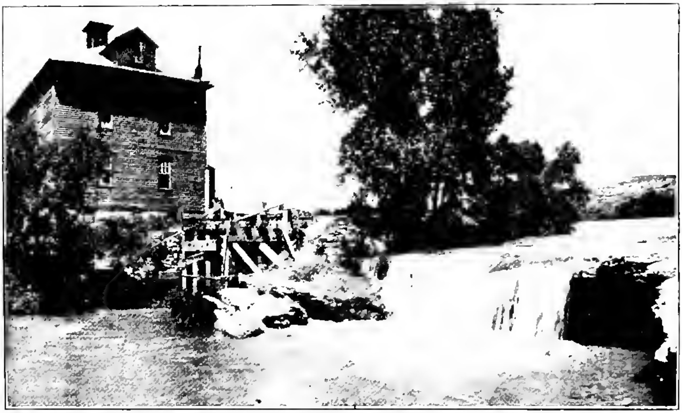

FIG. 31. WAUNETA FALL IN THE FRENCHMAN RIVER

The river is too shallow for boating, yet it affords some fishing. Its principal uses are for stock water, power (Figure 30) and irrigation.

The Frenchman River tributary drops over a hard ledge of rock at Wauneta, producing a beautiful fall of between seven and eight feet. (Figure 31) The stream is about 40 feet wide and changes little in volume during the year. The power of a part of this fall is used to run a flouring mill.

QUESTIONS AND EXERCISES

1. Why do rivers differ so much in size and flow? How and why do valleys differ?

2. At what places along the Missouri River are the bluffs steep?

3. Why is the Missouri River not used for water power in Nebraska?

4. Why are there but few bridges across the Missouri?

5. Describe the ferry boat shown in figure 17.

6. Compare the Missouri and Niobrara rivers. Compare their valleys.

7. Why does a heavy rain cause the Niobrara to rise but little?

8. Why are there several water falls in the Niobrara basin and none in the Platte River in Nebraska?

9. Which of Nebraska's waterfalls would you like most to visit? Why?

10. How many miles does the Platte flow in our state?

11. When do sandbars show plainest in a river?

12. Compare the Platte at high and low water stages. What causes it to rise and fall?

13. Why and how are rivers gaged? What is underflow?

14. What rivers of Nebraska overflow most? Tell why.

15. How and where do ice gorges affect transportation?

16. Which rivers of Nebraska are used most in irrigation? Why?

17. Why is more power used from the Blue rivers than from other streams in Nebraska?

18. Compare the Elkhorn and Loup rivers.

19. Compare the Platte and the Republican rivers.

20. How does the Republican differ from the Niobrara?

21. Is there a water power near your home? If so, study it and learn how it is operated. Compare figures 28, 30 and 31.

CHAPTER VIII

THE LOESS REGION

We shall next study the four provinces or topographic regions of our state.* The Loess Region ceceived its name from its surface formation and soil, the Loess, which is not much less than 100 feet thick at places.

Position and Area. This region occupies a little more than the southeast half of the state (Plate II) and extends into Iowa, Missouri and Kansas. The northwest edge of the region merges irregularly into the sand hills and extends southwestward to Colorado. The Loess forms high terraces in the Republican Valley in Dundy County, but eastward from Benkelman it spreads out and caps the uplands.

The area of the Loess Region in Nebraska is about 42,500 square miles.

Loess Plains. These are the least eroded parts of the region. (Figure 32) They are usually smooth, but here and there are shallow drainage-ways and slight knoll-like elevations. In some places the surface contains shallow, undrained basins filled by the rainfall at wet-weather times. Most of these small lakes dry up entirely during summer. The lakes occur principally in York, Fillmore, Clay and Phelps counties.

The landscape on the Loess Plains is unusually broad, only the curve of the earth hiding distant objects from view. We may ask, are these some of the 'level lands' of Nebraska? Yes, citizens often speak of them in that way; but there is very little of what is really level country. The land here is smooth and even; it slopes eastward with a grade of from 6 to 10 feet a mile, hence it is not level.

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* Study Omaha, Lincoln, Elk Point, Wahoo, Fremont, Grand Island, Kearney, Hastings, Superior, Red Cloud and Arapahoe topographic maps.

The Loess Plains show well about Cornlea (Platte County), David City, York, Dorchester, Fairmont, Hastings and Holdrege. We should locate these places on plate I and also study the relief map (Plate II) to see what counties in the Loess Region are smoothest.

Broad Valleys. The name Nebraska means "broad water." The broad rivers are in broad valleys which are a noticeable feature of the Loess Region. These valleys are but so many trenches in the upland. The principal valleys are the Missouri, Republican, Little Blue, Big Blue and those of the Platte system. The relief map (Plate II) shows the position, width, sides and something of the depth of each valley.

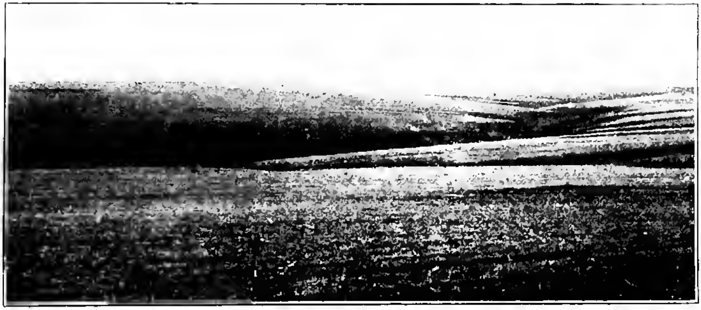

FIG. 32. AT THE EDGE OF THE LOESS PLAINS. RUN-OFF WATER ERODES THE SURFACE AT RAINY TIMES, MAKING THE LITTLE TRENCH LONGER, DEEPER AND WIDER. PHOTO BY U. G. CORNELL

Bottom and Bench Lands. The broad valleys have extensive bottom lands or flood plains. The Platte bottom is so wide in places that one cannot see both sides of the valley from one position. Most bottom lands are fairly smooth

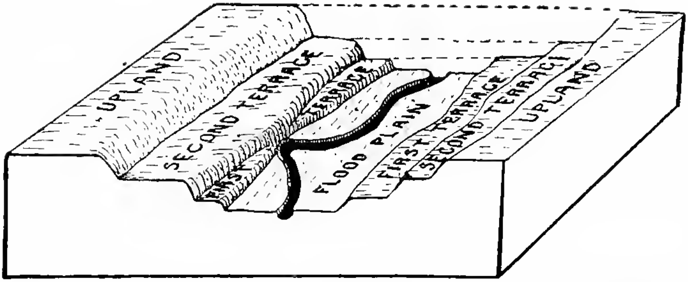

FIG. 33. IDEAL SECTION OF A VALLEY SHOWING ITS FLOOD PLAIN AND TERRACES

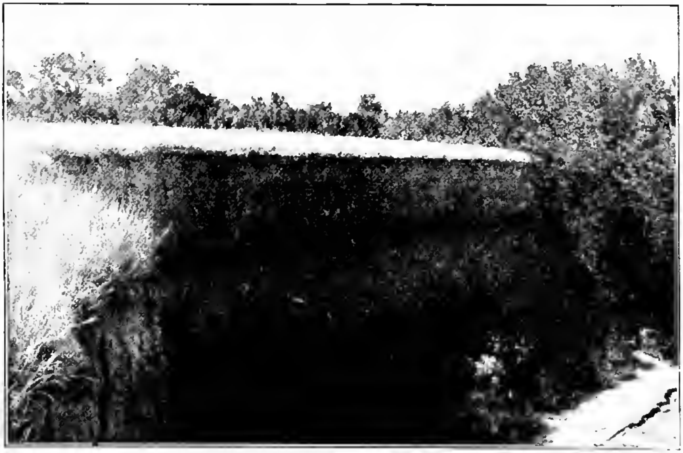

FIG. 34. REPUBLICAN VALLEY TERRACE, SOUTHWEST OF SUPERIOR

and their soils fertile and desirable, varying in texture from sandy to clayey. Such soils were deposited or made by the rivers.

These valleys also show alluvial benches or terraces (Figure 33) rising somewhat above their flood plains, and called the second and third bottoms. In places they resemble stair-steps, lying one above another, forming the valley sides, only the lowest of which become flooded. The terraces represent portions of old, high flood plains not yet destroyed by the down-cutting rivers. (Figure 34) At places where the Platte is overloaded with sediment it is building up its flood plain and thereby covering the terraces.

Todd Valley. This valley extends across Saunders County from between Morse Bluff and Cedar Bluffs to the Platte bottom northeast of Ashland.[2] It is 28 miles long, from six to eight wide, and quite smooth except for a few shallow drainage ways. It is 80 or 90 feet higher than the Platte at the north and about 40 feet above it at the south end, and located between higher lands both east and west.

It is not known just how the valley was formed. The Platte River may have flowed through it formerly, but if so it was a very long time ago.

Canyons. These are the deep, steep-walled ravines of the western states. They are deepened and lengthened by the run-off water flowing to the trunk streams, some of their beds being 100 and even 200 feet below the uplands. Most of the larger canyons of this region are in the western part, where they are usually near together with flat-topped divides between them. One of the best known examples is Trail Canyon, four miles east of Haigler, Dundy County. It is about 3 miles long and has a grade or fall of 300 feet. At the

[2] Fremont and Wahoo topographic maps, also An Old Platte Channel, by G. E Condra, American Geologist, p p. 361–369, June number, 1903.

time of a heavy rain, water rushes down the canyon with tremendous force, carrying away a vast amount of sediment.

The canyons are very young valleys in development, but not in years.

Rock Terraces. There are places in the region where the former Loess covering has been carried away by streams which are now wearing on the bed-rock. In valleys which contain strong and weak rock beds in their sides, the more resistant strata, by eroding slower than the others are caused to stand out prominently as ledges, some soil-covered and others bare. These forms, called rock terraces, are best shown in the Big Nemaha Valley where at places they extend for miles in the valley-sides. (Figure 35) They are arranged like great benches or steps resembling alluvial terraces and are best seen from high places.

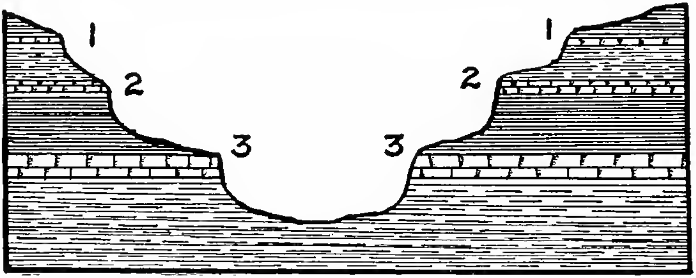

FIG. 35. DIAGRAM ILLUSTRATING THE ORIGIN AND OCCURRENCE OF ROCK TERRACES. THE STRONG LIMESTONES AT 1, 2 AND 3 STAND OUT AS TERRACES

River Bluffs. Where a stream cuts hard on either side of its valley, it forms steep banks popularly known as bluffs. There are several kinds of bluffs in the Loess Region, notably the Loess bluffs about Omaha, Fremont (Figure 22), and at many places along the Republican. Some of these exceed 100 feet in height. From the bluffs near Ponca, which are composed of Loess and Till above and rock beds below, one may see far into South Dakota and Iowa, with the broad Missouri in the foreground. At places the Niobrara chalk rock, the Dakota sandstone and the Pennsylvanian and Permian limestones form prominent bluffs which might be more properly called escarpments. The first-named occur along the Missouri in Boyd, Knox and Cedar counties (Figure 6), and along the south side of the Republican Valley in Franklin and Webster counties. They are usually steep and vary from 80 to 200 feet in height.

The rusty Dakota sandstone has been eroded into prominent ridges or escarpments along the Little Blue River in the southern part of Jefferson County, and at different places along the Missouri River between Ponca and Tekamah. Its escarpment is well-defined along the Platte between Ashland and South Bend. (Figure 5)

Ledges of Pennsylvanian limestone outcrop prominently along the lower Platte (Figure 4), the Missouri and its principal tributaries. The Permian limestone escarpment in the Big Blue Valley east of Wymore contains flinty ledges which rise from 75 to 100 feet above the river. In Jefferson and Thayer counties the Greenhorn (Benton) limestone forms light colored ledges high in the valley-slopes.

Ionia Volcano. A well-known bluff in the northwestern part of Dixon County has received this name. It was formed by the Missouri River cutting into thick beds of Benton shales. The bluff is over 150 feet high (Figure 36) and quite precipitous. The clays and shales composing it contain iron sulphide, a bronze colored mineral often found in coal. This mineral is oxidized or changes chemically in the presence of water, and at the same time some heat is produced. The

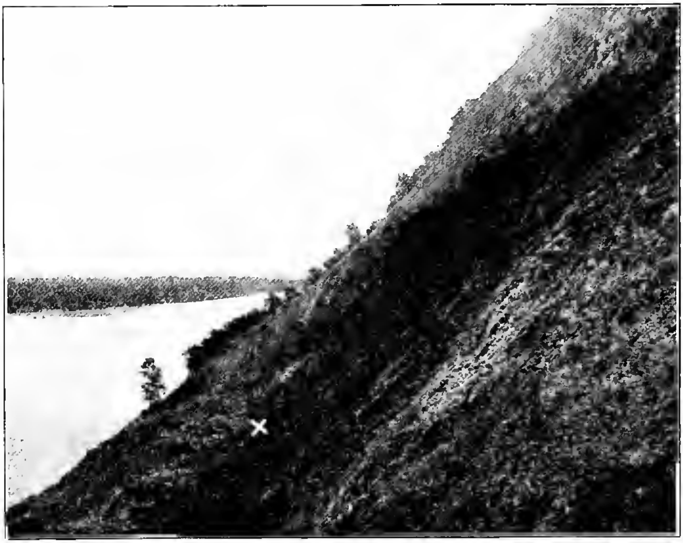

Fig. 36. The so-called Ionia Volcano. The Heated Part of the Bluff is at X

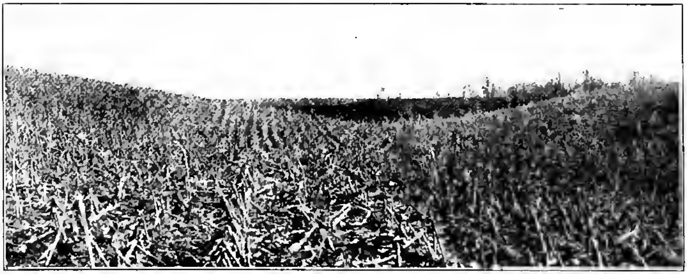

Fig. 37. Reduced Loess Hills in Saunders County

bluff is so warm that snow falling upon it usually thaws very soon but no volcanic materials have been thrown from this so-called volcano which was observed and described as early as 1804, by Lewis and Clark. There are similar hot banks, usually called "burning bluffs" or "burning mountains" in other states.

Several years ago a reporter from a prominent newspaper built a fire at a convenient place on this bluff and then photographed the smoke and flame which arose. That picture was used as evidence that Ionia Volcano had become active.

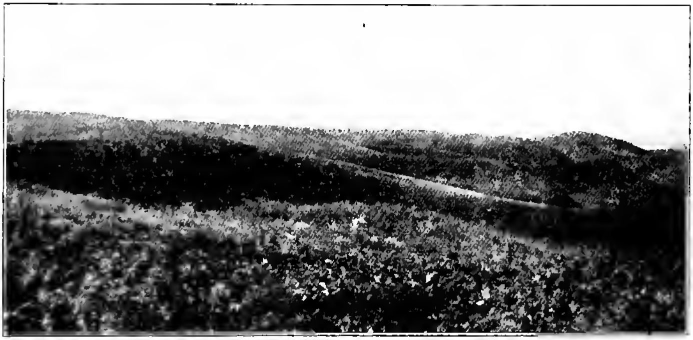

FIG. 38. PIERRE HILLS ALONG THE MISSOURI IN BOYD COUNTY. THESE HILLS ARE COVERED WITH CLAY SOIL WHICH SUPPORTS A THICK GROWTH OF PRAIRIE GRASS.

Hilly Lands. Thus far we have described the plains, the valley bottoms, canyons, and the bluffs of the Loess Region. Of these, the first two kinds named are smooth lands and the last two rough. Another type of surface occupies much of the eastern part of the Loess Region lying near the larger valleys, namely, the hilly lands. Here also is the heaviest rainfall and the greatest run-off. At places the streams have made not only canyons and bluffs, but have long since reduced most of them to hills. The flat-topped divides which formerly separated the small valleys have been washed away; the narrow gorges have been widened into small valleys, the sides of which the small tributary streams

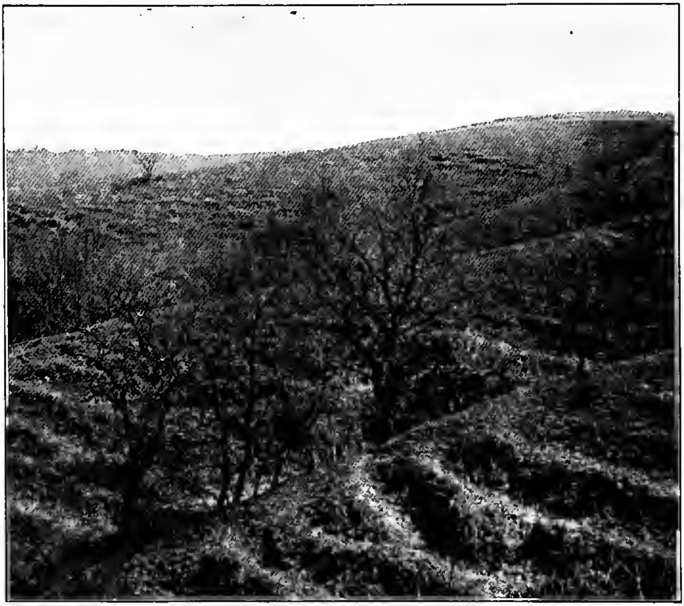

FIG. 39. CAT STEPS ON LOESS HILLS NEAR CEDAR CREEK, CASS COUNTY

carved and reduced into thousands of forms commonly called Loess hills (Figure 37); but, to be more exact, we should recognize that the term "hill" is falling into disuse. It was a change from young to mature valleys. Where the Loess has been entirely worn away, hills have been carved out of the underlying formations. Of these the glacial hills prevail at places in Lancaster and other eastern counties. Erosion of the Pierre formation has produced the billowy "Pierre slopes" and the "Pierre hills" so common in Boyd (Figure 38), northern Holt and Knox counties. Near the Missouri River in Knox County there is an aggregation of such rounded hills called the "Devil's Nest."

Loess Slips. These, locally known as "cat steps," are due to the creeping or slipping of the Loess in hillsides. Since the Loess is even-grained, it breaks or separates easily in an up-and-down direction. A view similar to that shown in figure 39 may be seen at many places in the rougher parts of the region. We observe in the view that the surface of the slope looks like steps and that the top of each slip is flat. The distance from one slip to another is about as far as a cat can jump, hence the name. These slips teach us that the Loess creeps readily to lower levels in a valley, concealing the underlying rock.

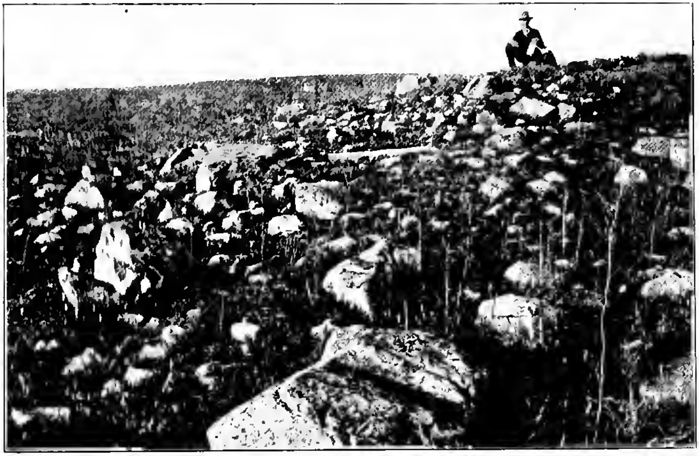

FIG. 40. A BOWLDER AREA NEAR ENDICOTT, JEFFERSON COUNTY. THIS LAND IS NOT EASILY PLOWED

Land Slides. At many places in the valleys of Boyd, Knox and Holt counties large masses of the Pierre shale break loose from the valley-sides and slide to lower levels. The slides are sometimes quite large, being 100 or 200 feet in length.

Smaller land slides occur in bluffs and deep railroad cuts where the Loess overlies glacial clay, the former slipping down over the latter where the ground has been thoroughly moistened by spring rains.

Bowlder Areas. At a few places in Nebraska glacial bowlders lie close together on the surface of the ground, the largest areas being in Jefferson County, one of them located southeast of Endicott (Figure 40) extending close to Steele City, and covering several sections of land. Some of the other areas are near Falls City, Humboldt, Tecumseh, Beatrice, Lincoln, and north of Hartington. Most of the bowlders are granite, sandstone, pink quartzite and limestone, which were carried to their positions by glaciers. They occur quite generally in the Till of Nebraska, but most on hill-sides, because there is where their former covering of Loess and finer glacial material has been carried away by the run-off water.

Summary of Conditions. The soils of the Loess Region are generally fertile, deep and easily tilled, even on the hills and uplands. There are several kinds of soil however, each having a somewhat local distribution, except the Loess which forms the subsoil of most of the uplands, and the alluvial soils which make up the bottom lands.

The annual rainfall is sufficient for crop production in the eastern part, but only 17 inches in the west. The run-off is greater in the east than in the west. Usually the well water is good and near the surface, the depth in the uplands increasing westward. Many wells dug through Loess are not walled.

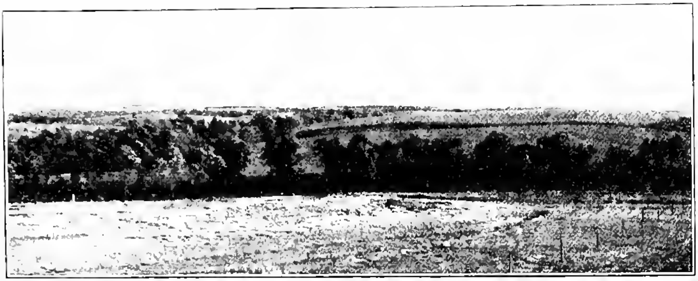

FIG. 41. TREES FOLLOWING THE WATER COURSES. PHOTO BY U. G. CORNELL

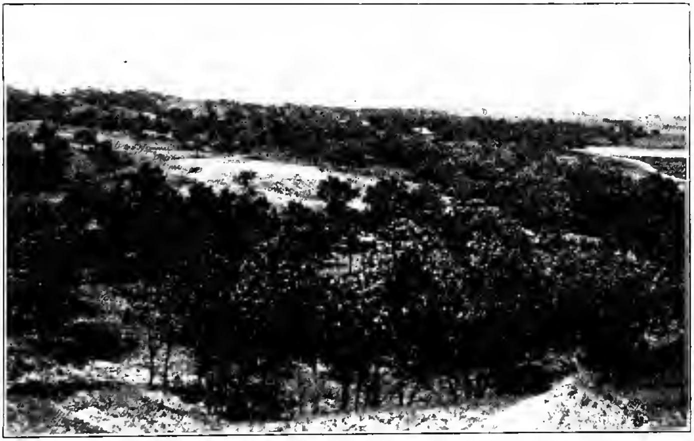

FIG. 42. BUR-OAKS MOVING INTO THE SANDY SLOPES NEAR DE WITT

Trees grow well over most of the region, except on the Loess Plains in the western counties. The native timber follows the waterways (Figure 41) usually. It is composed of cottonwoods, oaks, (Figure 42) elms, willows, ash, box elders, walnut and other related species. Saw-mills are operated at a few places.

Pasturage is confined principally to the wet flood plains, to the roughest lands, and to the dryer uplands. Grass grows thick and high in the eastern part which is the prairie country, and short in the west.

The principal building materials are clay, sand and limestone. The great lack is in fuel. The region is richest agriculturally in the eastern part where grain crops are raised in great variety. The region is the most thickly settled province of Nebraska. It is well improved both in the country and in the city.

QUESTIONS AND EXERCISES

1. What are level lands?

2. How and where are smooth lands made rough?

3. What is the widest valley in the Loess Region? The deepest?

4. On which side of the Platte is the rougher land? Of the Republican?

5. Where are terraces found, and how were they formed?

6. What kinds of bottom land are near your school?

7. What kinds of bluffs or escarpments have you observed and studied?

8. Are there any hilly lands near your home? If so, were they formed by streams or by winds? Are the hills changing now in form or in size?

9. Should we call Ionia bluff a volcano?

10. How do rough lands interfere with farming and traffic?

11. Why are there no bowlder areas in western Nebraska?

12. Where in the Loess Region do the following grow best and why, [1]grass, [2]trees and [3]crops?

13. Which part of the region is most thickly settled? Why?

CHAPTER IX

THE SAND HILL REGION.

Sand hills occur in the Great Plains from Minnesota to New Mexico, the best- known region being in Nebraska.[1] This might more properly be called the sand-dune region. If we were describing its soils, it should be known as the dune-sand region.

Position and Area. This region of Nebraska is a broad, irregular province, at places poorly defined.[2] It extends across the central and west-central portions of the state from northeast to southwest (Plate II), a few small sandhill areas lying outside the main region. One of the largest of these is south of the Platte at Kearney; others are near St. Paul, along the Loup River northwest of Grand Island, and in Lincoln, Chase, Perkins and Dundy counties.

The area of the region is about 18,000 square miles, though much of the surface is free from sand hills.

Structure and Origin. Usually the region is covered by a loosely compacted, fine-grained, wind-blown sand. Near its borders certain sandy ridges contain coarse gravel and even pebbles.

The sand hill formation is not thick, rarely exceeding 100 feet, while over much of the region it is considerably less. Beneath the wind-blown sands, beds of loosely compacted stratified sands outcrop in most of the valleys in the region.

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[1] Darton, N. H. Professional Papers, Nos. 17 & 32. U. S Geol. Survey; Barbour, E. H. Nebraska Geol. Survey, Vol. 1.

[2] Study Chappell and Browns Creek topographic sheet.

Without doubt the sand of the dunes or hills was blown into its present forms, and similar changes are taking place at the present time. The region, then, is not very old. Most of the sediment now forming the hills was blown from the easily eroded underlying formations. The distance which it was carried varied from a few feet to several miles. The Sand Hill Region was formed principally by northwest winds blowing over sandy formations at dry times. Some of the loosened sediment not protected by vegetation is now carried in a southeasterly direction by the winds prevailing at the time of greatest dryness.

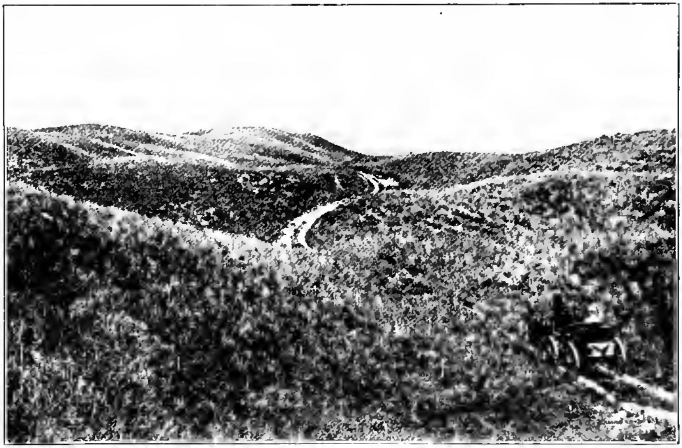

Fig. 43. A Typical Sand Hill View. Photo by R. A. Emerson

Dunes and Ridges. The dunes (Figure 43) vary in form and size, rarely exceeding 100 feet in height and usually not more than 25 to 50 feet. In diameter they range from 100 feet or less to 100 yards or more. The form may be described as conical, the smaller hills giving a billowy appearance to the

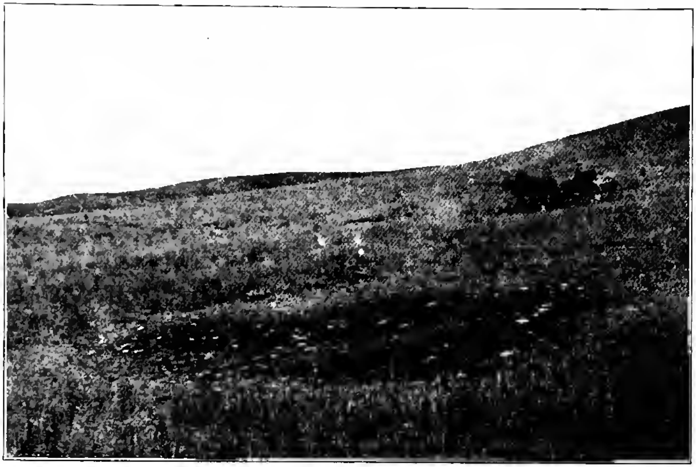

Fig. 44. A Sand Hill Basin in which Water has stood

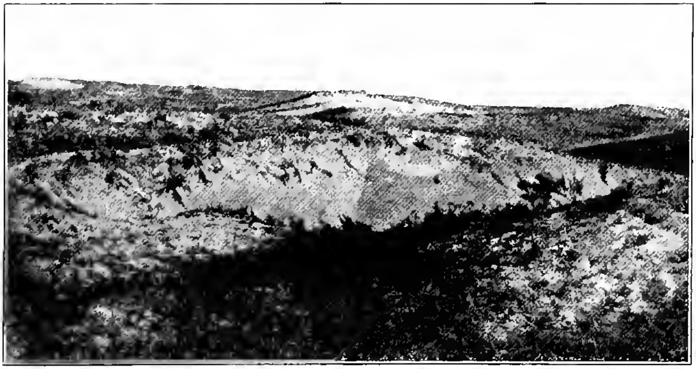

Fig. 45. Sand Hill Blow-outs—one in the Foreground and Two in the Distance. Photo by R. A. Emerson

landscape where close together. The ranges or ridges were formed by the union of dunes which traveled in a common direction under the influence of the wind, prominent examples of which are found near the Dismal River south of Thedford.

Basins and Dry Valleys. Almost everywhere in the region one sees saucer-like basins (Figure 44) between the dunes, and elliptical, dry valleys between the ranges. The largest and more continuous dry valleys look much like the bottom lands of rivers. At places the basins and valleys make up a large part of the region.

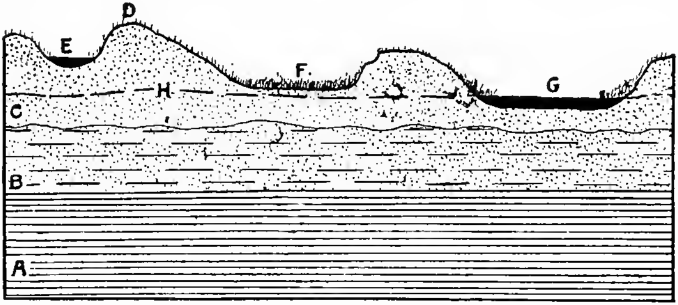

Fig. 46. Section in the Sand Hills showing: A, Impervious Beds; B, C, Stratified and Wind-blown Sands filled with Water; D, Sand Dune; E, Wet-weather Pond; F, Dry Valley; G, Lake; H, Water Table

Blow-outs. These are crater-like holes made in the surface of the land by wind. (Figure 45) They are a common feature in the sand hills, usually occurring on the windward sides of dunes, where often the sand is removed to depths of 10 to 20 feet or more.

Blow-outs are not confined to dunes and ridges, but may be seen also on smooth lands where a sandy soil has been plowed. The blow-outs begin to form at places where the soil is uncovered; from this spot sand is removed little by little and thus a cavity is made. As the work goes on vegetation is uprooted and a typical blow-out with its barren surface results.

Surface Drainage. The sandhill region contains few streams, those which are present having a continuous struggle with drifting sand. Some of the old valleys which formerly were occupied by rivers are now filled with sand. The river valleys have few or no tributaries. Their streams are abundantly supplied by spring water but with little or no storm water.

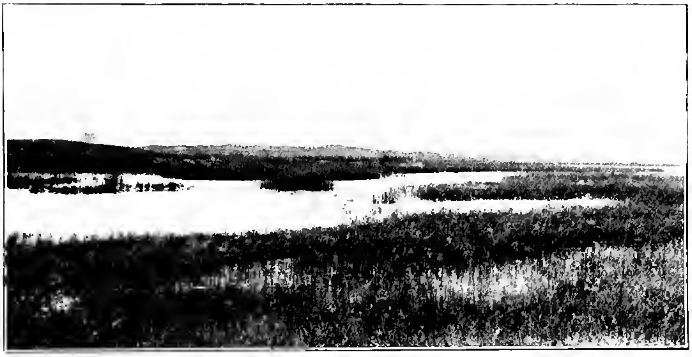

Fig. 47. Watts Lake in the Sand Hills. Photo by E. H. Barbour

There is little surface drainage. For miles in the hills proper no stream-channels are seen. This, then, is the second characteristic feature of the region, the other being a wind-formed topography.

Ground Water. The open-textured sandy soil absorbs most of the rainfall. Though the amount of moisture evaporated from the soil is large, there is not as much loss in that way as some have thought, a surface mulch of sand preventing excessive evaporation. Much of the rainfall percolates downward through the sand and becomes ground water. The water table is nearest the surface at a distance from the river valleys, rising and falling with the wet and dry years. (Figure 46) The amount of ground water in the Sand Hill Region is great, more than would be expected with the rainfall. Capillary water is present in the sand at a distance of a few inches below the surface, extending from this point to the water table below. The ground water varies from that of good quality to that which is somewhat alkaline.

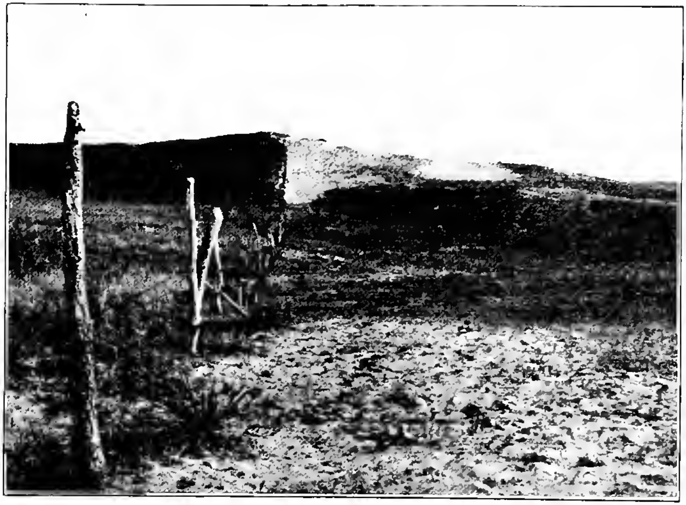

FIG. 48. GRASS LAND. THE LAND TO THE RIGHT OF THE FENCE HAS BEEN "OVERGRAZED." PHOTO BY R. A. EMERSON

Lakes. These are numerous in some places, notably in Brown and Cherry counties. The origin of sand hill lakes is now quite well known. The rainfall of the hills soaks downward, becoming ground water. The water table is never exactly level; it levels up in the region and thus rises above the bottoms of the lowest basins and valleys, forming lakes. (Figure 47) Since the lake surfaces are level and the water table slopes southeastward, much of the ground water enters the lakes at their western and northwestern ends as seepage springs. It has been observed that the lakes grow larger and deeper during periods of heavy rainfall; and smaller and shallower at times of light rainfall. They are important as a source of stock water; and are the stopping places of many ducks and geese during their migrations, when hunters slaughter them too freely. A few lakes afford good fishing.

Wet Weather Ponds. These are more common than the permanent lakes, and their origin is not hard to explain. The rainfall is mostly caught by the sands on the hill slopes, but during a dashing rain some of it runs to the basins below. This run-off carries the finest sediment to the basin floors and silts them, i.e. makes them more impervious to water. Later, plant growth further assists in sealing the basins, causing them to hold more of the storm water. After a basin is thus formed it holds storm water for a short time after a heavy rain, but not permanently, for the supply is soon lost by evaporation and by percolation. These ponds are not exposed ground water tables, in many cases the water table lying several feet below them. (Figure 46) The height to which water has stood in a basin may be told by the darkened soil. (Figure 44)

The Soils. The soils of this region are very silty and sandy with only a small amount of clay. Soil on the dunes and ridges contains very little humus. Some of it is wafted about by wind and at such places is not fixed in position. It contains little plant food. The basin and valley soils are more fertile. The percent of arable land in the region is not known, yet there are desirable farm lands in certain dry valleys and about the lakes.

Vegetation. This has been called the thin grass country, the grass standing quite thin on the dunes but increasing in amount in the basins and dry valleys. More kinds of grass grow here than elsewhere in the state, due to the great variety of conditions. The principal enemies of vegetation are drifting sands, over-grazing (Figure 48), fires and occasional drouths. Some grasses appear to increase and decrease in amount with wet and dry periods, the growth of certain kinds thickening during the times of heaviest rainfall while others decrease. The grasses which cover the sandy slopes and ridges are mostly the hard-stemmed and hard-leaved varieties. Most ridges are occupied by tufts of grass which do not form a perfect sod, the bunch grass being the most noticeable kind. Buffalo and gramma grasses form irregular patches where the soil is close-textured and dry. The sharp yucca plant is found at places, and small cacti are present but not plentiful. (Figure 49)

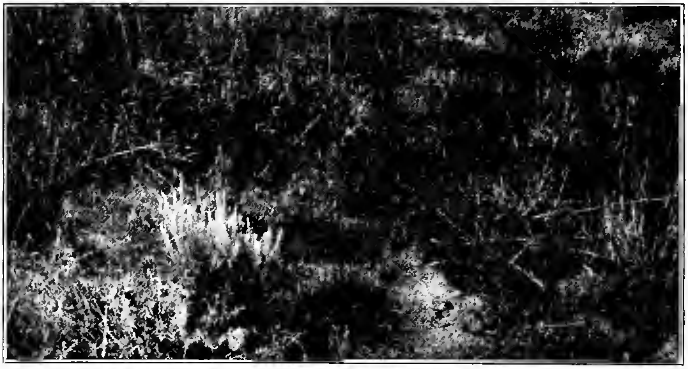

Fig. 49. Native Grasses at Edge of Sand Hills. Small Cacti show in the Foreground

Wild fruit grows here, raspberries, sandcherries, and plums being most plentiful. Among the widely-scattered shrubs are the wild rose, dogwood and the greasewood. Sage brush is found locally, but most near the edge of the region, giving a ragged appearance to the country. The shrubs shade the ground and also protect it from wind. Patches of plum bushes and similar growths constitute what are known as plum thickets, which occur in the pockets and basins and extend on to slopes facing southeast. (Figure 50) These thickets are shelter for wild fowl such as the grouse and meadow lark, and a home for raccoon, the natural habitat of the last named animal being in timbered regions.

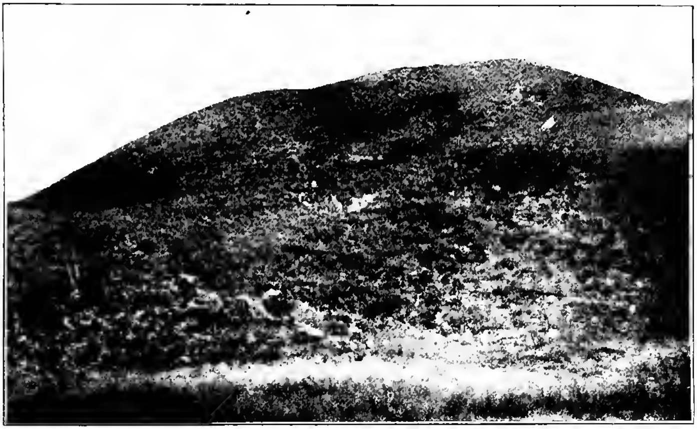

FIG. 50. PLUM THICKET IN A SAND HILL BASIN. A LARGE DUNE SHOWS IN THE DISTANCE

Cottonwoods, box-elders, species of ash, and in some places cedars and pines extend part way into the sand hills, their stumps occurring yet farther away from the rivers. So there is some tree growth in the Sand Hill Region at present, and there may have been more in the past.

Roads and Travel. The average sand hill road is little more than a trail, winding about from ranch to ranch or from town to town. Section lines are not followed in the hills. Travel is not bad when roads extend along the dry valleys, but where they cross a succession of dunes and ridges it is most wearing. While passing across these basins and valleys the rider is reminded of the firm and faster roads which prevail in the Loess Region. The wagon lunges forth as it gains the firmer ground and slows up as it again strikes the sand. The riding is without jolt, but very hard on teams. Wide tires are used on most vehicles to keep them from sinking into the sand. This is not a region of bicycling or of rapid driving, horseback riding being the quickest and easiest means of travel.

Summary of Conditions. The rainfall is nearly all absorbed by the soil, producing an abundance of ground water, coming to the surface in places as lakes. Wells vary much in depth, ranging from a few feet to over 100 feet, some of them affording an abundance of stock water.

The topography is unfavorable for travel. For the most part the soil is not adapted to the growth of farm crops. There is practically no building stone, and the supply of fuel is small.

The region produces varying quantities of grass which serves for pasturage and for the production of hay. Where the grass is thin as many as 20 acres are required to pasture a single cow or horse, which means that ranches are necessarily large if many animals are raised on them. Hay is cut in dry valleys and basins and corn and alfalfa are grown at places. As a whole the Sand Hill Region has a thinly scattered population, whose interests are centered mostly in stock-raising.

QUESTIONS AND EXERCISES

1. Compare the Sand Hill and Loess Regions in size?

2. What is the source of the sand hill sand?

3. Compare dunes and ridges. Compare basins and dry valleys.

4. By what means is sand kept from blowing?

5. How do rivers of the sand hills differ from rivers of the Loess Region?

6. What are the characteristic features of the Sand Hill Region?

7. At what places in this region is the water table nearest the surface?

8. How are wet-weather ponds formed, and why are they so named?

9. Give the origin and uses of sand hill lakes.

10. Compare the vegetation of the Sand Hill and Loess regions.

11. Why is the grass growth thin on the dunes and thick near the lakes?

12. Why are the ranches large?

CHAPTER X

THE HIGH PLAINS REGION

This region is quite unlike the sand hills in appearance. It receives its name from its altitude and smooth surface, though it contains some very rough lands[1]. This province is known also as the Table Land and Butte Region.

Position and Area. This region has a wide range east of the Rocky Mountains, extending from Canada to New Mexico, and occupying the western part of Nebraska. The eastern boundary grades irregularly into the Sand Hill and Loess regions. This border has been eroded unevenly by the Niobrara, Platte and Republican rivers, and modified into sand dunes between the valleys.

The area of the High Plains Region in Nebraska is about 16,000 square miles, not including small detached parts lying eastward along the principal valleys and in the Sand Hill Region.

Structure and Origin. The surface formations are composed of thick beds of sand and gravel. The topmost formation south of the North Platte River is a light colored. limy sand rock locally known as "magnesia" and "mortar bed rock." The mortar beds and the sandy beds combined vary from 300 to 600 feet in thickness, decreasing eastward. Next below these are thick layers of bad land clays extending under much of western Nebraska and outcropping in some of the valleys, while below these formations are yet older rocks. Thus we find that the upper beds of the region are limy and sandy, while the deeper exposed ones are more clayey.

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[1] Study Sidney, Chappell and Scotts Bluff topographic maps; Professional Paper No. 17; Water Supply, Paper No 70; Camp Clark and Scotts Bluff folios.

The materials composing these surface beds were carried eastward from the mountains by rivers and spread widely over the entire region. Finally, after the rock beds were formed with a nearly smooth surface, they were elevated and then the rivers began to saw deep valleys in them.

Valleys. Since the High Plains were formed they have been destroyed in part by flowing water. The high altitude of the region gives swift rivers which erode the land rapidly. The North Platte, Niobrara, White, Pumpkinseed and Lodgepole valleys are so many troughs which have been carved in the original High Plains or table lands. Of these, the Platte Valley is the largest and deepest, its depth being from 800 to 1,200 feet with sides ranging from those that are gradual to abrupt cliffs 400 to 700 feet high. The width of this large valley from table land to table land in Scotts Bluff and Cheyenne counties varies from 10 to 15 miles. Pumpkinseed valley is a wide tributary of the Platte while the Lodgepole and the Niobrara valleys are smaller. White River Valley is

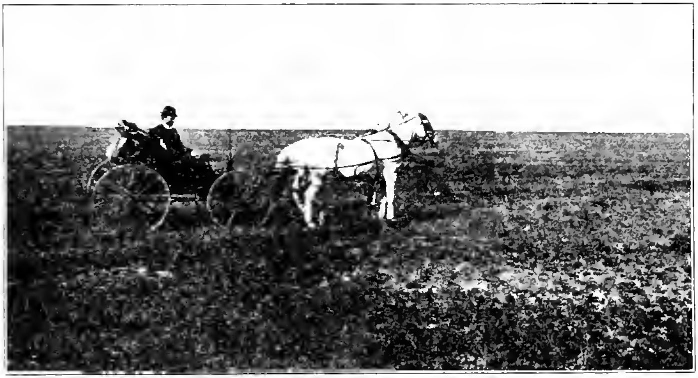

FIG. 51. VIEW OF BOX BUTTE PLAINS NEAR HEMINGFORD
Photo by U. G. Cornell

the northern limit of the High Plains Region in Nebraska, its table land wall being the Pine Ridge escarpment.

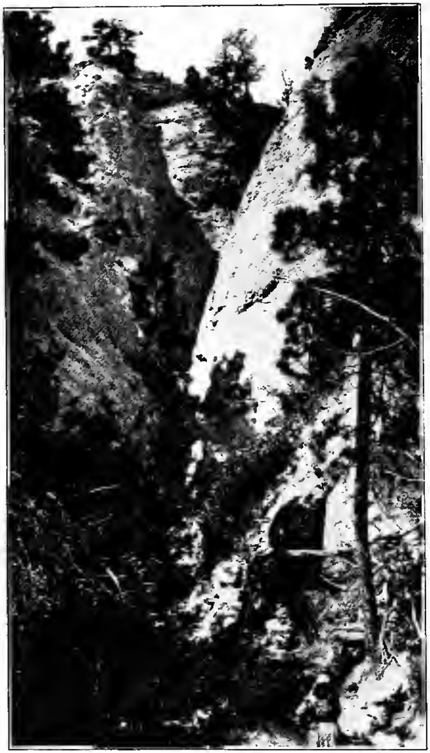

FIG. 52. CARTER CANYON AT THE EDGES OF NORTH PLATTE VALLEY
Photo by H. A. Mark

High Plains Areas. These are the most elevated portions of our state, constituting the undissected parts of the original High Plain surface. (Figure 51) Two principal areas embracing most of the table land surface of the state are called the Cheyenne Plains and the Box Butte Plains.

The Cheyenne Plains are shown typically in Cheyenne County, hence the name. They are the eastward extension of the elevated surface lying from Pumpkinseed Valley southward. The land to the south of Lodgepole Valley is practically a part of this area, being separated by the small Lodgepole Valley only 300 feet deep. The Cheyenne Plains are about 100 miles in length from west to east in Nebraska, and at palces 40 miles wide. The surface is quite smooth with a slope eastward of from 10 to 15 feet per mile, the storm water accumulating in shallow depressions as small intermittent ponds.

The highest points, about 5,300 feet in altitude, are in the southwestern part of Banner County. The table land view is open, impressing one with the vastness of the country.

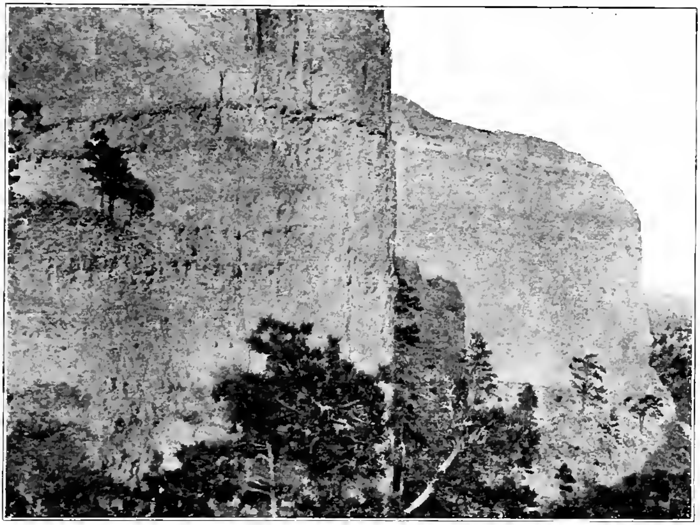

FIG. 53. A LARGE BUTTE NEAR CRAWFORD

The Box Butte Plains lie in the vicinity of Hemingford, Box Butte County, where some 500 square miles of the High Plains constitute a typical table land. Its altitude ranges from about 5,000 feet in the west to about 4,000 feet in the east, extending from the North Platte Valley to Pine Ridge and from near Wyoming eastward across Sioux, Box Butte, southern Dawes and the northern part of Sheridan counties. The surface is even, excepting the roughened land near the Wyoming line, while a few local sand hills give contrast to the usual table land conditions. The Niobrara Valley extends across the table from west to east, but is not deep or large enough to separate it into two distinct areas.

Canyons and Buttes. These are features of the roughest parts of the High Plains Region. The canyons are deep, steep-walled ravines made in the plains or table lands by run-off water. (Figure 52) They are similar in origin to those of the Loess Region, but larger and more diverse in appearance.

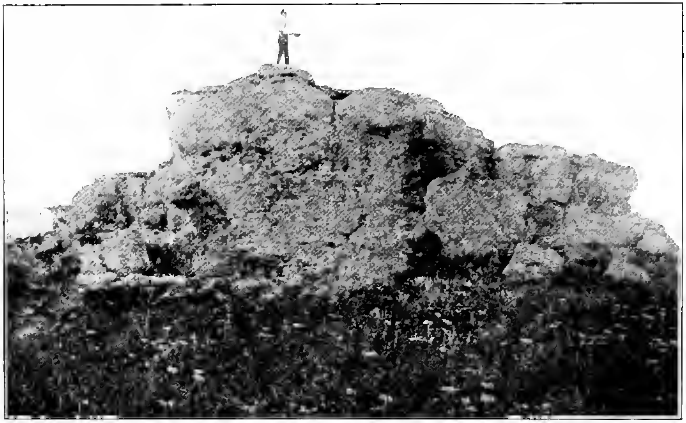

FIG. 54. SUMMIT OF THE LARGER TWIN BUTTE, BOYD COUNTY

The buttes also were carved out of the original table land. (Figure 53) They are parts of the High Plains which have not been worn away, standing out prominently, some being of mountain height, the tops of a few remaining as high as the original table land. In most cases the original topmost beds of the High Plains have been entirely removed by erosion, the hard beds lower down becoming the tops of the buttes. Where this has happened the summits of the buttes are lower than the remaining plain of which they were once a part. In the eastern and most eroded part of the region, certain stony hills and buttes mark the former extent of the table lands in that direction, examples of this kind occurring in Cedar, Knox, Boyd and Franklin counties. Twin Buttes in Boyd County constitute a prominent land mark, their summits rising to an altitude of 2050 feet or nearly 200 feet above the surrounding country, being visible many miles northward in Dakota and from five or six counties in Nebraska. They are capped with a hard rock (Figure 54) beneath which is sand and deeper down a second hard rock resting on clay or shale.

There are hundreds of large buttes in the High Plains Region, bearing such names as Lover's Leap, Signal Butte, Look out Mountain and Crow Butte; they are also called mountains, chimneys, castles, etc. The largest buttes occur in Pine Ridge and in Wild Cat Range, where the country is of mountain altitude and scenery.

Pine Ridge. This is Nebraska's most prominent topographic feature, receiving its name from the pine trees covering it in places. (Figure 55) The ridge is a high escarpment in the northwestern part of the state, extending from Wyoming through Sioux (Figure 56), Dawes and Sheridan Counties in Nebraska and into South Dakota. It is the north edge of the Box Butte Plains facing in the direction of the Black Hills. The ridge was formed by the erosion of White River and some of the branches of the Cheyenne River. Its crest is about as high as the table lands to the south. The slope northward has a descent of from 800 to 1,000 feet, while the ridge is much roughened by buttes and intervening canyons. From the vicinity of Harrison a long spur extends northeastward between Hat Creek and White River basins. The deepest trenches in Pine Ridge occur in Sioux County where Sowbelly and Monroe Canyons are among the best-known. Of the numerous buttes

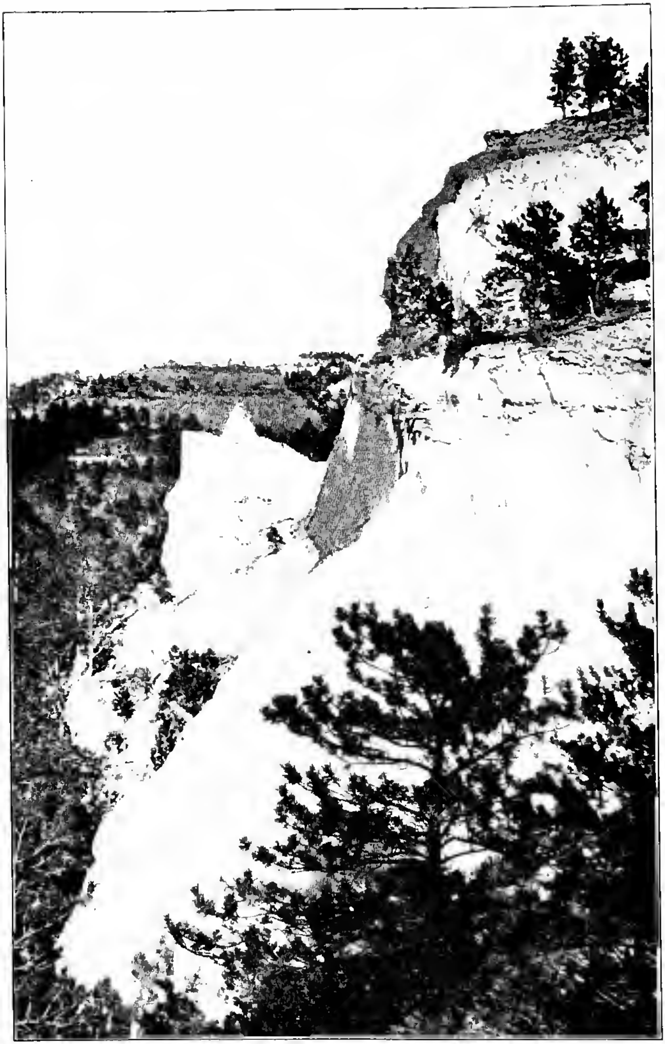

FIG. 55. AT THE EDGE OF PINE RIDGE
Photo by N. H. Darton

in and near this escarpment Coliseum Rock, northwest of Harrison and Crow Butte just east of Crawford are best-known.

Wild Cat Range. This ridge or range is nearly as well-known as Pine Ridge, though from a lack of transportation facilities it has been difficult to reach it until recently. During the early settlement of the far west some of the buttes and other forms constituting this range were objects of wonder to emigrants passing over the Oregon Trail.

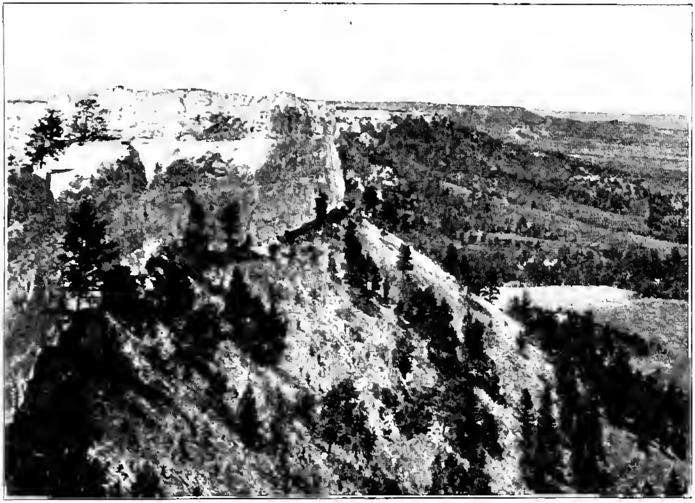

FIG. 56. PINE RIDGE NEAR THE NEBRASKA-WYOMING LINE
Photo by N. H. Darton

The range lies between the North Platte and Pumpkinseed valleys and is about 50 miles long, extending south of east from Bald Peak and Signal Butte to Court House and Jail Rock. The width is about 10 miles to the west, gradually lessening to the east. Its distance from the Platte varies from 6 to 12 miles, with three prominent spurs coming still closer. The first of these is Scotts Bluff (Figure 57) with an altitude of 4,662 feet and a bold slope of nearly 800 feet on the north; the second is Castle Rock with an altitude of 4,473 feet and steep sides 675 feet high; while the third is Chimney Rock. Though not so high as the others, the last-named is one of our best-known topographic forms, standing out prominently in the Platte Valley and being visible for many miles. Court House and Jail Rock stand out as disconnected members of the range, near Bridgeport, Cheyenne County. A prominent spur of Wild Cat Range extends a short distance to the southeast, terminating in Hogback and Wild Cat mountains, which rise as high as the plains to the south; the first-named of these has an altitude of 5,082 feet and the second 5,038 feet. Their tops are 700 feet above Pumpkinseed Valley to the south, and about 1,150 feet above the Platte Valley to the north. The canyons in this range are deep and large. Roads and trails leading across the range are called passes at their highest points.

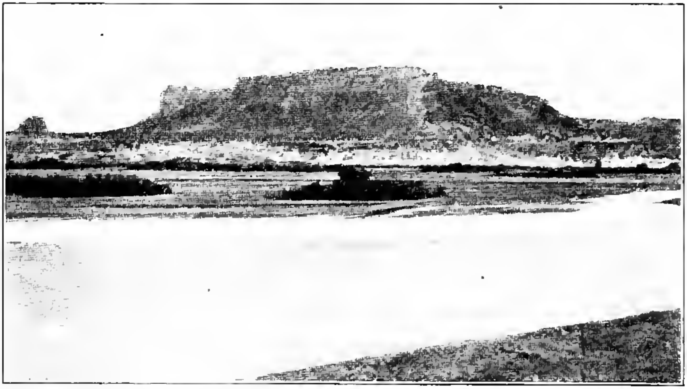

FIG. 57. SCOTTS BLUFF AS SEEN FROM A DISTANCE WITH THE NORTH PLATTE RIVER IN THE FOREGROUND
Photo by N. H. Darton.

Professor C. E. Bessey first proposed the name, Wild Cat Range for this collection of buttes and high points. The range was eroded out of the Cheyenne Plains by Platte River and Pumpkinseed Creek. Court House and Jail Rock (Figure 58) at the east end of the range are lower than the rest; their tops are capped by resistant beds lying far below the original surface of Cheyenne Plains which formerly extended northward across where now is the North Platte Valley.

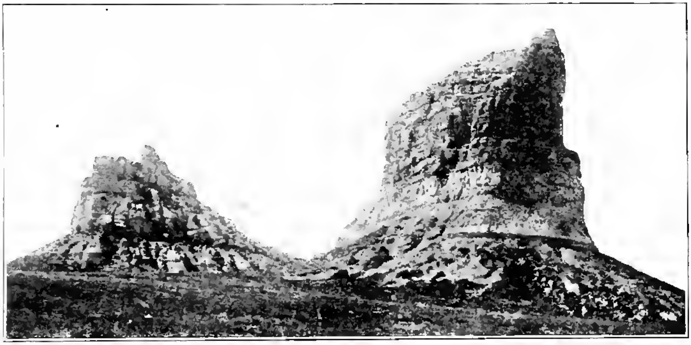

FIG. 58. COURT HOUSE AND JAIL ROCK
Photo by E H Barbour

The buttes of the High Plains Region are more prominent than some mountains in the Appalachian System and most of western Nebraska is higher than the best-known mountains of New England.

Water Supply. Much of the rainfall, though light, is absorbed,[1] becoming ground water, yet at the time of a driving rain the direct run-off is considerable on the rough lands, though slight on the smooth plains. The quality of water is generally good but locally alkaline. The water table is near the surface along the valley bottoms, and 100 to 300 feet deep in the uplands. The water of the plains is very pure, being soft to medium hard, while many of the canyons contain springs with the same quality of water.

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[1] Adams G. I. Water Supply Paper, No. 70, U. S. G. S.

Vegetation. The High Plains Region is known as the short grass country. The soil is covered by a mat consisting of several low grasses, the principal kinds being buffalo, gramma, wheat and needle grasses, varying in importance in different places. Many of the sand hill species also occur in this region. The grass sod protects the soil from erosion by wind and run-off water. On valley and other moist lands the grasses grow high and heavy, yielding large quantities of hay. Small cacti are scattered over the table lands. Several kinds of shrubs grow in the canyons and in the open country, the sage brush principally on the sandy ridges between the valleys and uplands. (Figure 59.) The common wild fruits are the buffalo berry, plum, cherry, currant, gooseberry and

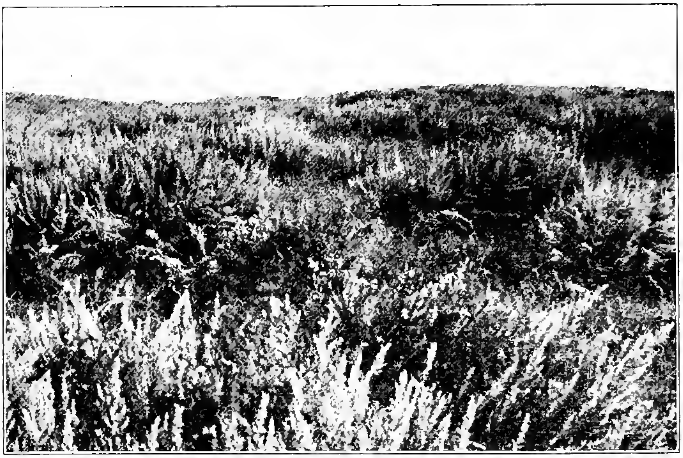

FIG. 59. SHRUBS RESEMBLING SAGE BRUSH

sandcherry, the last-named growing best on open, sandy lands.

The tree growth is composed principally of pines (Figure 60), cedars, cottonwoods and willows, the two last-named growing best on bottom lands or near ground water, while the pines and cedars are found on the canyon walls and higher places, especially on slopes facing northward.

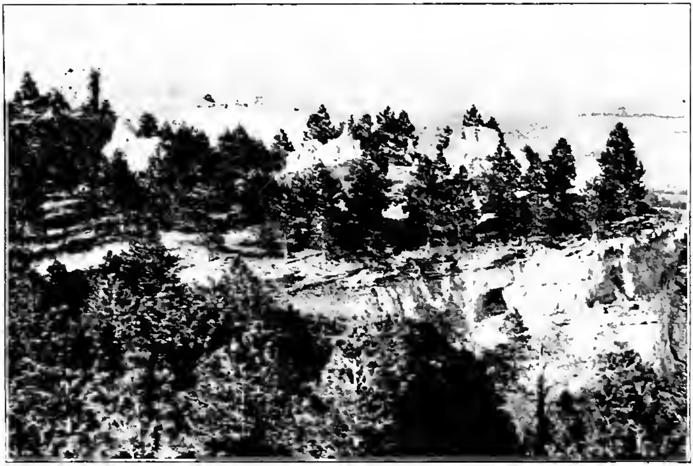

FIG. 60. PINES TREES ON PINE RIDGE
Photo by E. H. Barbour

Summary of Conditions. The mean annual rainfall of the High Plains is not sufficient for the growth of late maturing grain crops except those that are drouth resisting. The North Platte River is fed by mountain water, its flow continuing during the summer. Wells are usually deep on the plains and shallow on valley floors.

The soils of largest distribution are classed as close textured, sandy and alkaline. They are usually fertile and readily tilled where the land is smooth. Stony and pebbly soils are found locally. The topographic forms vary from smooth plains to mountainous areas. Wagon roads are uncertain on the steep valley slopes and good on the table lands. The amount of bottom and bench land is considerable, with a fair supply of irrigation water.

Grasses vary from those that are short and thick to those that are high enough to produce hay. The only fuel of any consequence is the tree growth. Sand, gravel, sod and some stone constitute the building materials. Native timber is employed locally for building purposes and for fuel. Cattle-raising, dairying and farming are the principal industries. Except where irrigation is practised, the country is sparsely settled, though more thickly than the sand hills.

QUESTIONS AND EXERCISES

1. How are the High Plains and the Sand Hill regions alike in structure? How unlike?

2. Is the High Plains Region becoming smoother or rougher? Give reasons for your answer.

3. Compare the Cheyenne and Box Butte plains.

4. What are intermittent ponds and why cannot they be depended upon as a source of stock water?

5. How are buttes and canyons alike in origin? Is a canyon anything?

6. Why are some buttes steeper than others? Higher, or lower? Would our state have buttes if there were no hard beds of rock?

7. Compare Pine Ridge with Wild Cat Range.

8. How does the vegetation of the High Plains Region differ from that of the sand hills? How is it similar? What difference in roads and crops?

9. Which of the regions just named is the more thinly settled, and why?

10. Where in the High Plains may one see mountain views, and experience a mountain climate?

CHAPTER XI

THE BAD LAND REGION

The name of this region was proposed by Frenchmen at an early date, meaning a country difficult to travel through.[1] The region has been a retreat to the Indian; a hindrance to travel and railroads and to the geologist the "Good Lands," for it is a great fossil field. In some respects this is the most interesting part of our state, though from an agricultural standpoint much of it is waste.

Position and Area. It is an extension to the southwest of the Dakota Bad Lands. Fortunately for Nebraska, only a small portion of the region, about 1000 square miles, lies within its borders, and not all of that is a bad land surface. The main parts of the region in this state are beyond or north of Pine Ridge, and are confined to White River and Hat Creek basins, the two being separated by a spur extending northeastward from the High Plains. The floor of the Bad Lands lies at an altitude of from 800 to 1,000 feet below the crest of Pine Ridge.

Beyond or north of the Bad Lands proper, in Nebraska, the Pierre shale, an alkaline formation, comes to the surface and occupies part of the province. Another bad land area is in the North Platte Valley at the foot of Scotts Bluff.

Structure and Origin. The typical bad land formation is a light buff gray, sandy clay which geologists call the Brule clay. It is over 500 feet thick, underlaid by a more sandy and resistant light buff colored formation containing some sand

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[1] Barbour, E. H. Nebraska Geol. Survey, Vol. 1, pp. 143 to 152. Darton, N. H. Professional Paper No. 17, U. S. G. S., pp. 37-41.

and gravel. This lower layer is the Chadron formation, its thickness varying from 25 to 100 feet.

The Brule clay outcrops in Pine Ridge, beneath the sandy members of the High Plains. Originally the Box Butte Plains extended northward across most of the present Bad Land Region of Nebraska, the Brule clay then lying 600 feet or more below the surface. (Figure 61.) The High Plains strata were removed by the White and Cheyenne rivers. During all of the time of erosion Pine Ridge retreated southward, and this process is still taking place. As soon as the rivers lowered their beds to the Brule clay the Bad Lands began to form. Where exposed, the Brule clay or typical bad land formation weathers and erodes rapidly, its fine texture causing a large amount of quick run-off, promoting excessive erosion for the amount of rainfall. Run-off water carves its surface into thousands of little rills. Since the formations erode so readily it did not take the rivers long, geologically speaking, to sculpture them into typical Bad Lands, and in places to entirely wear them away. In Toadstool Park, a well-known bad land form, we find two types of surface, the Brule clay above, and the Chadron below. Thus some of the bad land surface is formed out of the Chadron lying below the Brule clay.

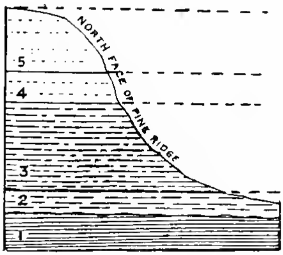

Fig. 61. Section showing how the Brule clay, number 3, out-crops along the north face of Pine Ridge. The sandy beds 4 and 5 formerly extended northward across what is now the Bad Land Region. Number 1 is the Pierre shale and 2, the Chadron Formation

The steps in the origin of the Bad Lands were about as follows: First a great fresh water lake was filled with clay sediment and covered later to a depth of 600 feet or more by sands; second, the country was elevated, giving an increased slope eastward; third, the surface was dissected by streams which removed the sandy beds above and eroded the underlying Brule clay and Chadron formations as we now find them in their bad land form.

Topography. The land forms in this region are a marked contrast to those of the High Plains and the Sand Hill Region. (Figure 62.) In other words the Brule clay and the Chadron formation erode into different forms from those of the High Plains sands and gravels. A bad land slope, where much dissected, is very irregular, containing pinnacles, spires and knobs, some of which are steep, their sides being hard to climb. (Figure 63.)

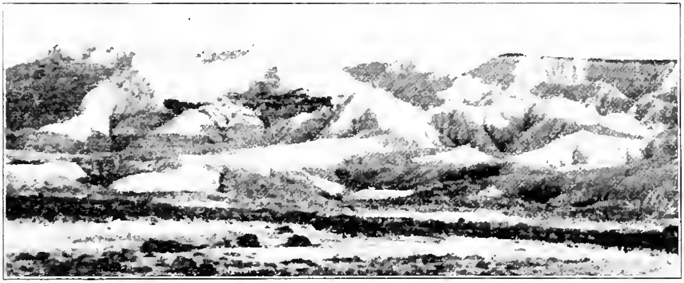

FIG. 62. A BAD LAND VIEW NEAR ADELIA
Photo by E. H. Barbour

Tourists often confuse the rougher parts of Pine Ridge with the Bad Lands proper, not realizing that a rough surface is not necessarily a bad land area. The prominent buttes in the vicinity of Crawford are at the edge of the Bad Lands, but not a part of them.

Water Supply. The well water is poor in quality and limited in quantity. Fortunately the streams flowing through the region are fed by springs in Pine Ridge, affording the only sure supply. The principal stream is White River, named from its light colored, turbid waters which prevail at flood time.

Vegetation. At places, comprising about one-fourth of the area of the province, the ground in the Bad Land Region is entirely bare and arid. The lack of vegetation at such places is caused more by rapid erosion than by the light rainfall. The soft clays wash away so rapidly that plants cannot obtain a footing on steep slopes. In protected spots, however, and on gradual slopes, the grass covering is quite thick. Along the streams we find shrubs and trees.

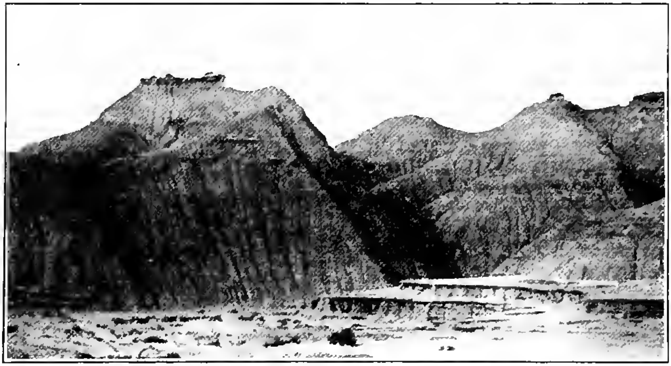

FIG. 63. A BAD LAND VIEW AT THE EDGE OF TOAD STOOL PARK
Photo by E. H. Barbour

Utilization. Thus far the Bad Lands have had little economic importance. The water is poor, the topography unfavorable, the soil alkaline and unstable. Stock-raising is the only agricultural industry aside from farming in a small way. Geologists and geographers often make trips to the region for the purpose of studying erosion and topography.

An important though not valuable resource is the large number of fossils buried in the clays and sandy beds, many of which have been secured and shipped to the principal museums of the world. The Nebraska State Museum has a number of fossils which were collected by the State Geologist, Professor E. H. Barbour, and as a result of the financial assistance of Hon. C. H. Morrill. Among the fossil animals collected are the turtle, tiger, tapir, rhinoceros, horse and monkey, each very different from the skeleton of any living animal of the kind.

QUESTIONS AND EXERCISES

1. Why are the Bad Lands so named?
2. Which state has the more bad land surface, Nebraska or South Dakota?
3. What is an alkaline formation?
4. How do we know that the sandy beds of the High Plains Region formerly extended northward over the bad land formations?
5. In what respects is this an interesting region?
6. Why is it poor agriculturally?
7. How did the fossil turtles come to be in this region?
8. Why is bad land water of poor quality?
9. Compare bad land and sand hill views.
10. Do you think of any means whereby the Bad Land Region might become a more inviting place in which to live?

CHAPTER XII

SETTLEMENT AND DEVELOPMENT OF NEBRASKA

Nebraska is a part of the Louisiana Purchase secured from France in 1803.[1] When Missouri became a state in 1820, that part of the unorganized territory lying to the north and west of that state was called the "Indian Country." In 1854 Nebraska Territory was set aside from the Indian Country with its boundary extending westward on the present southern line to the summit of the Rocky Mountains and northward along that summit to the 49th parallel; thence eastward to about 103 degrees of west longitude, thence southward to the Missouri River, and down its main channel to the place of beginning.

At different times Congress decreased the size of Nebraska Territory by the creation of new territories, but after its admission as a state, March 1, 1867, the area was slightly increased by an act passed March 28, 1882, transferring from Dakota to Nebraska the land lying between the Keya Paha and Niobrara rivers and the present northern boundary.

The Indians. The country was occupied by Indians before the time of the Louisiana Purchase, and before white men came westward. There were four main tribes in the eastern part of what is now Nebraska: the Otoes, who lived in the vicinity of Plattsmouth and Nebraska City; the Mahas, or Omahas, along the Missouri Valley but north of the Otoes; the Pawnees, who held most of the territory between the Republi-

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[1] For a brief and interesting reference, read Historical Sketch of Nebraska by A. E. Sheldon.

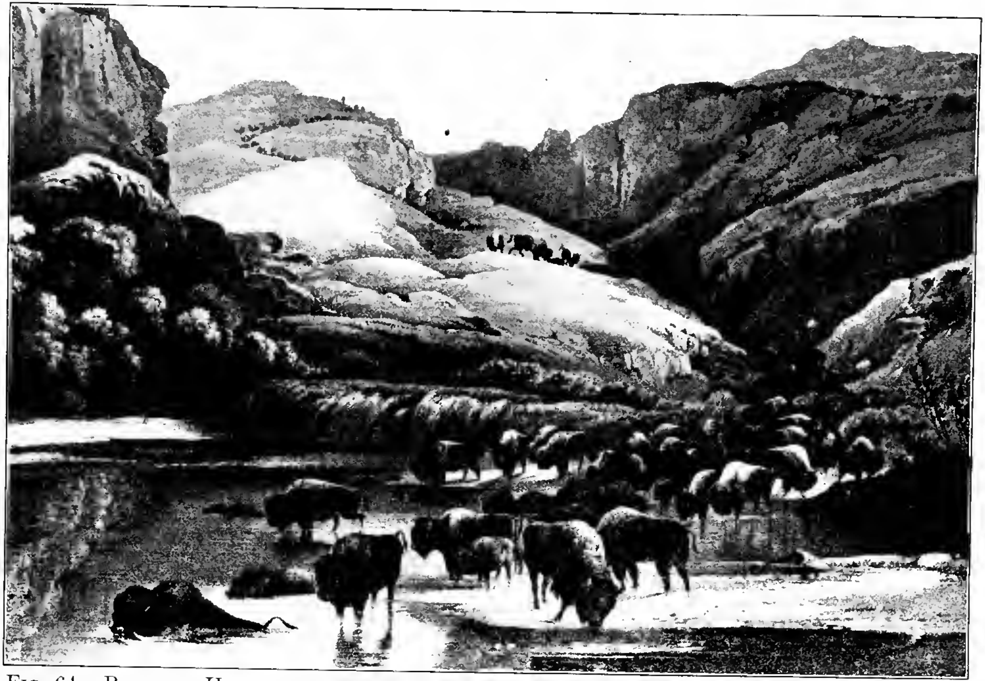


Fig. 64. Buffalo Herd trailing to their Watering Place. Photo from an Old Steel Engraving owned by the State Historical Society

can and the Loup Valleys, and the Poncas, near the mouth of the Niobrara River.

The western and northwestern parts of the state were the hunting grounds of the above named tribes, of the Cheyennes and Arapahoes and of the Sioux Indians of Dakota who often came into conflict with the Pawnees. The hunting grounds contained large herds of buffalo (Figure 64), droves of deer, elk and antelope which were the objects of the chase, and which became the source of much of the Redmen's food, clothing, materials of shelter and even of his fuel. The Indians killed their large game with spears and with bows and flint-pointed arrows. The buffalo meat was cut into pieces and allowed to dry in the sun for use as food between the hunting seasons. The Indians lived in lodges composing villages which they abandoned twice each year for the hunting grounds. Their lodges were crude structures built of animal skins, poles, sod and bark. The "tepee" (Figure 65) was the type of home possessed by the plains tribes; the dirt lodge by the Pawnees and the bark lodge by the Winnebagoes. (Figure 66.) The plains Indians were the most nomadic.

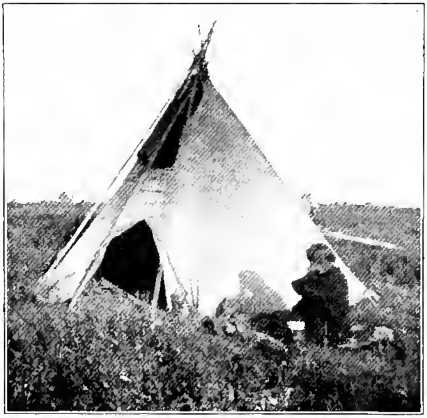


FIG. 65. INDIAN "TEPEE" OF THE SIOUX INDIANS
Photo by E. C. Bishop

In a simple way the Indians were adapted to their environments. The forests, streams and plains meant only the bare necessities of life and pleasure to them.

The four first-named tribes came to Nebraska from the east and southeast between 200 and 500 years ago. Other tribes were brought here by the government when the Indians were placed on reservations. The Winnebagoes were brought from Wisconsin and Minnesota and placed on the northern part of the Omaha reservation in 1862, and the Santees from Minnesota to their reservation in Knox County in 1866. The Sac-and-Fox-and-Iowa reservation of Kansas extends for a short distance into Richardson County, but it has less than 300 Indians within its borders, very few of whom live in Nebraska.

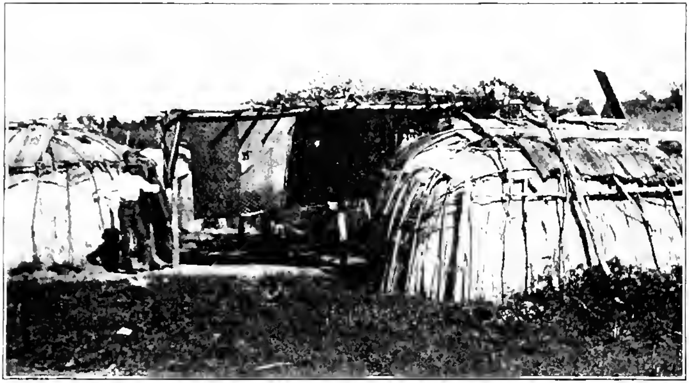


FIG. 66. BARK LODGES OF THE WINNEBAGOES, THURSTON COUNTY
Photo by A. E. Sheldon

Few Redmen live in Nebraska now, the white man's whiskey and diseases having claimed most of them. At times small-pox alone reduced the tribes one-half. Finally the government removed the surviving Pawnees, Poncas and Otoes to Oklahoma and Indian Territory — the Pawnees in 1875, the Poncas, against their choice, in 1877, and the Otoes in 1881. Later a few of the Poncas were allowed to return to their old home in Nebraska. There were about 6,000 Indians in the state in 1890 and 3,000 in 1900. So the Indians have surrendered their land and dwindled in numbers all within the memory of our oldest settlers.

Explorers, Traders and Trappers. A few French explorers and traders visited the territory previous to 1803. In 1804 the Lewis and Clark Expedition, under control of the National Government, passed up the Missouri River along the eastern border of our state, making a number of landings. At two places they held council with the Indians who promised allegiance to the United States. Later, other expeditions were sent into and through this region.

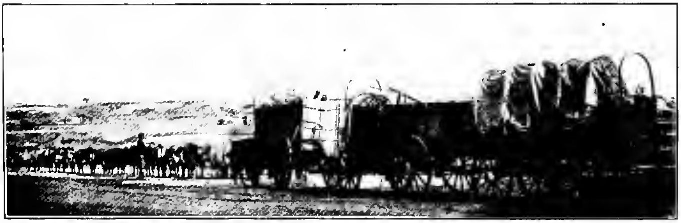


FIG. 67. EARLY METHOD OF FREIGHTING PRACTICED IN SOUTH DAKOTA AND NEBRASKA

Photo by the State Historical Society

Traders and trappers in larger numbers followed closely the explorations. Indian trade became an object. Between 1805 and 1854 many trading posts were established at the most accessible points along the Missouri, the first being in Dakota County. White men moved freely in the Indian Country; furs and buffalo skins were collected at the various trading posts and taken by boat to St. Louis.

The first white men, then, who came to the territory were attracted by trade. They did not come for the purpose of farming as the land was thought to be worthless.

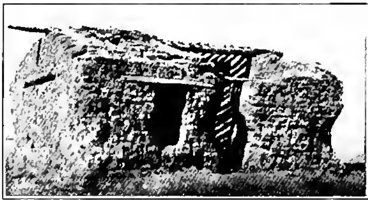
Overland Routes. In the second place, people from the east wished to go through and beyond Nebraska, at first to Oregon and later to California, Colorado and to the Black Hills. The first trip overland was made in about 1831. The various routes of which the Oregon Trail was the best known followed the valleys, which were the natural roadways, furnishing a supply of water and fuel. Beginning with 1844 the number of emigrants passing west was rapidly increased.

The Mormons crossed the plains in 1846. Then came the gold seekers by the thousands, and overland freighting increased in importance. The freighters with their heavy wagons and ox trains held sway for twenty years (Figure 67), carrying goods from the main outfitting posts to mining camps. With the freighters came and disappeared the overland post route, stages and pony express, which were the forerunners of our present rapid transit. The hardships then endured are quite a contrast to the present experience in traveling and freighting.

It was on these trips across the plains that large herds of buffalo were seen. These animals were killed for food, but usually slaughtered too freely, resulting in their rapid extermination.

Early Settlers. The traders and trappers did not come to make homes; neither did the Indian agents who were sent by the government. After these came the missionaries and the settlers or "squatters," as they were called. It is said that Stephen Story was the first squatter, locating in the southeastern part of the territory in 1844, before white men had a right to take claims. Soon the Indians ceded land to the government and squatters became settlers by preempting land. Each was allowed 160 acres for which he promised to pay $200. The first free homestead was filed in 1863.

Settlers entered Nebraska from the east, as the Indians had



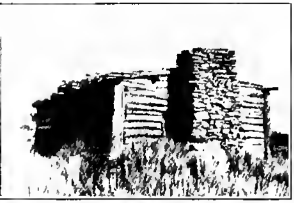


FIG. 69. ABANDONED "SODDY"
FIG. 68. LOG SCHOOL HOUSE, NOT NOW USED

done many years earlier. White settlements began in the Missouri Valley on the southeast and progressed northward and westward into the tributary valleys, the migration soon extending westward into other valleys, following the streams, timber and stone. By 1870 the land of the Blue River valleys was filed.

As soon as the fertility of the upland soil became known and it was found that water could be obtained there at no great depth, settlements extended to the Loess Plains also.

The first houses near the woodlands were made of logs (Figure 68) and those on the Loess Plains were dugouts and "soddies" (Figure 69), while stone was used where it was accessible. (Figure 70.)

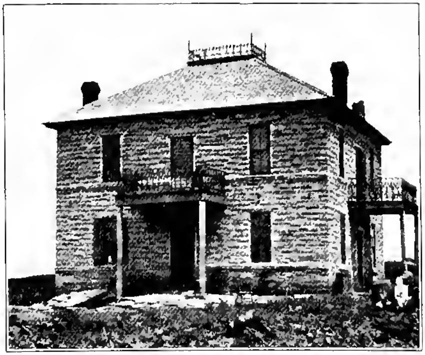


FIG. 70. STONE HOUSE
Photo by C. A. Fisher

The homesteaders became farmers. They went to work on their claims, breaking land and putting up buildings. Large crops were raised, except during grasshopper years and periods of drought, though at times there was little demand for corn and wheat, for without railroads these products were too far from market. In some places corn was used for fuel.

Usually the Indians were friendly to the settlers, but in 1854 and 1855 they caused some trouble. During the summer of 1863, the Pawnees killed many men, women and children in the frontier settlements. Forts were established for the protection of emigrants and settlers.

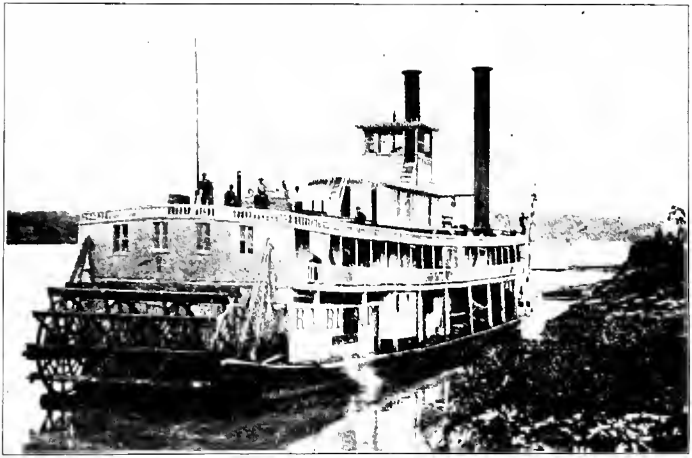


FIG. 71. AN EARLY MISSOURI RIVER STEAMER
Photo by E. A. Sheldon of the State Historical Society

During the early settlements the western part of the territory became the cattle and cowboy country. The range was not fenced, being free to many thousands of cattle which were driven north in the spring and south in the fall. So, gradually, the white man's cattle took the place of the Indian's buffalo. The large cattle owners were then called "cattle kings."

The Missouri River. This river was an important factor in the early development of Nebraska. Down its course were carried the cargoes obtained from Indians and trappers. The first boats used were small and crude affairs which soon gave way to steamboats. (Figure 71.) Beginning about 1830 the steamers made regular trips up and down the river between St. Louis and the trading posts, carrying stores for overland freighting, supplies for settlers, and passengers of all sorts. Furs, cattle and grain, in order, were the principal cargoes carried down-stream. It was north and south traffic by way of the Missouri and the Mississippi which together formed a great natural transportation gate-way to the northwest, much to the advantage of St. Joseph, Kansas City and especially of St. Louis. Steamboat navigation continued for about forty years.

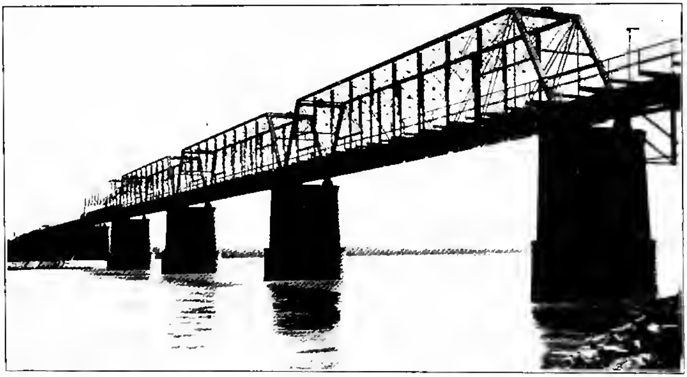


FIG. 72. UNION PACIFIC BRIDGE AT OMAHA

Railroads. The first railroad to cross Nebraska was the Union Pacific, extending from Omaha to the Platte, thence westward along that valley and the Lodge Pole to Wyoming and beyond to the Pacific coast. The road was finished across the continent in 1869, but it hauled freight and passengers in Nebraska three years earlier. The Platte Valley, one of the finest roadways in the world, was an important factor in determining the location of this first trans-continental railroad, but the Missouri River was an obstruction difficult to span. (Figure 72.) Soon the main line of the Burlington was built to Lincoln and then to Denver. Another line of the same system extended from Lincoln to the Black Hills and beyond. The Northwestern built from Omaha to the Black Hills, later constructing a number of branches and connecting lines. A railroad which is now a part of the Burlington system was constructed from Nebraska City to Lincoln at a somewhat earlier date. The Rock Island, the Missouri Pacific and a number of other systems finish the list.

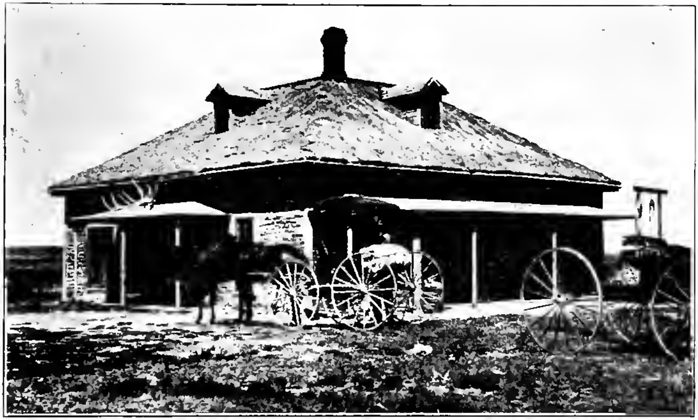


FIG. 73. MODERN SOD HOUSE OF WESTERN NEBRASKA
Photo by E. H. Barbour

The railroads first built through Nebraska to points westward wishing to reach the coast and later Denver and the

Black Hills. As a result of such constructon our state has six trans-continental railroads, affording sure train service between the larger towns. Later, each system extended its connecting lines, especially in the eastern counties; in all there are over 10,000 miles of railroad in the state, reaching most towns of any size. The largest system is the Burlington, while the Northwestern is second in mileage.

The topographic features have had much to do with determining the locations of the railroads in Nebraska. The roads followed the valleys and smooth lands to the west and northwest, penetrating the Sand Hill Region by following up the river valleys, then along the dry valleys to the high plains. The Platte and the Republican bench lands afford good roadways, especially on the north side of each.

The coming of the Union Pacific and other railroads revolutionized transportation. It meant the death of steamboat and overland freighting. The stage coaches were either driven out of business or caused to select routes at right angles to the railroads. The direction of transportation changed from north and south, to east and west, with Chicago and New York City as the favored cities rather than Kansas City and St. Louis. The products of the farm and city found in the railroads a quick means of transportation to the large markets.

FIG. 74. MODERN RESIDENCE OF A WELL KNOWN NEBRASKAN
Photo by U. G Cornell.

During the past few years a strong demand has arisen for more north and south lines, and the roads are now building in that direction. There also is promise of a number of interurban electric roads, and of an extension of connecting lines of each railroad system.

With the railroads have come the fast mail and telegraph. These with a nearly universal telephone service, give the state quick communication.

Climatic Influences. The homesteaders had fairly prosperous times until the early seventies when the rainfall decreased and when grasshoppers destroyed the crops in 1874 and 1875. Hard times prevailed until near the close of the seventies, when the rainfall became heavier for another period of years and with it came a return of prosperity and railroad building. Homesteaders pushed westward during the wet years, and the country filled up rapidly until the wave of settlement swept over the whole of the High Plains Region and into the isolated valleys of the Sand Hill Region. The advance was resisted, but unsuccessfully, by the cattlemen; the day of free range and large ranches had passed, at least for a time. Heavy rainfall favored the farmers who grew large crops in the short grass country. The manufacturing interests of the state made a strong advance, especially in the larger towns of the eastern counties.

In 1890 the rainfall again decreased, followed four years later by a severe drouth. Farming in the western counties, except under irrigation, failed, and as a result most of the homesteaders in the western counties abandoned their places and turned eastward. Farming with their methods and their crops had been carried too far into the sub-humid area to stand dry seasons, and the agricultural population dwindled during the remaining dry years. Grazing interests increased, and the cattlemen again controlled the country. The sod houses tumbled down (Figure 69) causing the country to appear the more desolate. The prairie dog and the coyote were less molested in their native haunts.

Within a few years another increase in rainfall set in, and farming has since proved successful over all of the High Plains.

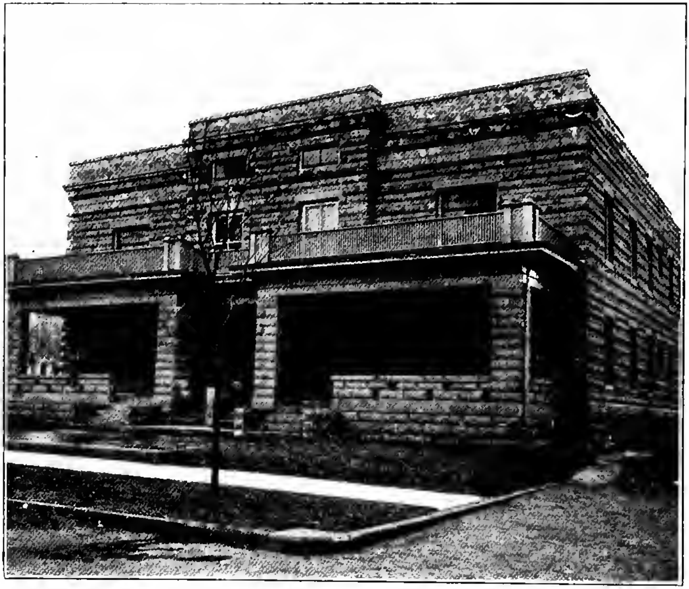


FIG. 75. CEMENT HOUSE

This time the farmers have new crops and dry farming methods. There is also an extension of railroads and a great advance in manufacturing, with promise of more permanence of development than before. Improvements prevail in the country town and city. The sod houses of the high plains are either disappearing or being replaced by others of a more permanent kind. (Figure 73.) Throughout the state modern dwellings (Figure 74) are supplanting those of the older types.

Cement, sand, gravel, and crushed stone are now used in increasing amounts in what are called "cement houses." (Figure 75.)

Population. The people of Nebraska show a high average in industry and intelligence, though the increase in population has been rapid. Immigration has come largely from the states east of Nebraska and from foreign countries, the foreign peoples in the state being largely Germans, Swedes, Norwegians, Bohemians and Russians.

FIG. 76. A TYPICAL TOWN SCHOOL GROUND AND BUILDING, FLORENCE, NEBRASKA

In 1854, at the time of the organization of the territory, the population was 2,700; in 1860 it was 28,841; in 1870 it was 122,993; in 1880 it had increased to 450,402; in

1890 to 1,058,910, and in 1900 to 1,068,539. The report of 1890 is thought to have been too high. The population now, is considerably greater than in 1900.

Education. It is in this line that Nebraska has made most remarkable development. The first Nebraska school was taught near Bellevue by Mrs. Joseph P. Merrill in 1833, the pupils being Indians and halfbreeds. The first Territorial Legislature passed a free public school act March 16, 1855, and the first State Legislature made wise provision for the maintenance of the schools. Mt. Vernon College (Methodist) was founded at Peru in 1866, becoming the State Normal in 1867. The Institute for Deaf and Dumb was established at Omaha in 1869, and the State Industrial School at Kearney in 1870. The University of Nebraska at Lincoln dates back to 1871; the Nebraska School for the Blind was established at Nebraska City in 1875; the Institute for the Feeble Minded Youth at

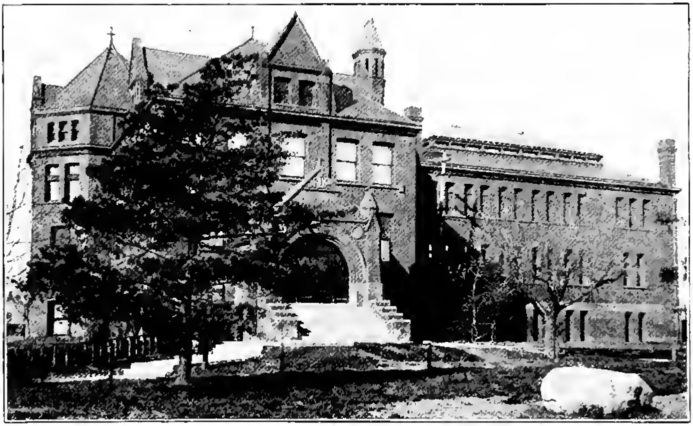


FIG. 77. LIBRARY BUILDING, UNIVERSITY OF NEBRASKA
Photo by U. G. Cornell

Beatrice in 1885, and the Girls' Industrial School was separated from the school at Kearney and located at Geneva in 1892. The second State Normal was established at Kearney in 1904, opening its doors to a large enrollment in 1905.

In these schools Nebraska has made provision for the education of both the fortunate and unfortunate boys and girls, and for her mechanics, farmers, lawyers, physicians and teachers.

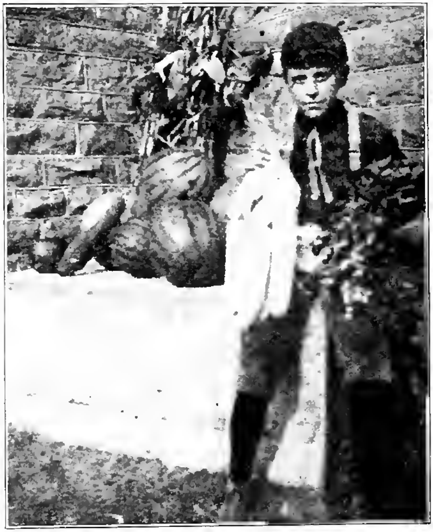


FIG. 78. A YOUNG AGRICULTURALIST AND HIS PRODUCTS
Photo by E. C. Bishop

To-day public school instruction is free from the first grade through the high school, normal school and the University of Nebraska, a student being expected to finish the high school by the age of twenty-one. In 1905 there were 6,767 school houses (Figure 76) with 9,714 teachers in the state. There were 379,014 school children of school age, i.e., between the ages 5 and 21. The Normal schools afford training for a large number of teachers, while the University has a total enrollment in its various schools and colleges of about 3,000 students. (Figure 77)

Besides the public schools there are many successful parochial, private and denominational academies and colleges in Nebraska. Among these schools and colleges may be mentioned the large private normal colleges at Fremont and Wayne, the Presbyterian colleges at Bellevue and Hastings, the Baptist college at Grand Island, the United Brethren college at York, the Congregational college and academies at Crete, Chadron, Franklin, Neligh, and Weeping Water, the Methodist university at University Place, the Adventist college at College View, the Episcopalian academies at Omaha and Kearney, the Lutheran academy at Wahoo, and the Danish college at Blair.

The Catholic Church maintains strong and well managed schools in the nature of academies at Falls City, York, Lincoln, Omaha, O'Neill, Humphrey, Columbus and a large number of other places.

Creighton University (Catholic) at Omaha is a large and well equipped school and stands strongly for higher education.

Nearly all of the colleges and universities named above are of state wide influence and have the power, as have the state educational institutions, of issuing teachers' certificates to graduates of their normal courses. The motto of these Nebraska schools is "each for all and all for each," and a strong fraternal feeling prevails among them.

Agricultural Education. Under the efficient management of the state superintendent and his deputy and with the coöperation of the various educational institutions much emphasis is placed on what is called a practical education. There is an endeavor to thoroughly prepare students for the occupations which they are to follow. This means that our boys and girls should study things agricultural, for most of them are interested, either directly or indirectly, in the farm and its products. Since Nebraska is naturally an agricultural state, there is, on that account, a demand for agricultural education.

For a number of years, the soils, crops, and other matters of the farm were studied by farmers alone, but now the boys (Figure 78) and girls of the state are more interested in seed corn, breeds of animals and school gardening (Figure 79) than their parents ever were. In this regard, as we should expect, Nebraska is leading the other states. Agricultural instruction is given in a number of high schools and colleges.

There is opportunity for boys and girls who complete the eighth grade in the public schools to enter the short courses in the School of Agriculture and the School of Domestic Science at the University of Nebraska and there receive instruction in the simple things of the farm and farm home. More advanced work is taken in the college course in agriculture.

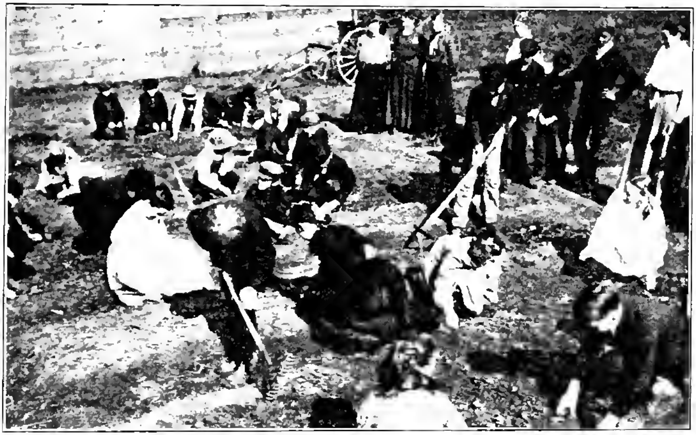


FIG. 79. THE SCHOOL GARDEN. CHILDREN PREPARING SEED BEDS, SARPY COUNTY
Photo by E. C. Bishop

Various state organizations promote the interests of agricultural education.

Geography and Politics. Since the earliest settlements, the Platte Valley has been a dividing line in politics. At times the line of division has decreased in importance, but only to be emphasized anew at some later period.

In a study of the settlement and development of the state, we may note that the smallest counties are in the east and the largest in the west, their areas having been determined by settlement and that largely by rainfall. The geography has likewise influenced the size of congressional districts and other political divisions of the state.

QUESTIONS AND EXERCISES

1. What states are now a part of what was once Nebraska Territory?
2. Why did the Indians dwell most in valleys?
3. How did the early Indians make fires? Cut wood? Kill their game? Travel? Farm?
4. Why did they farm so little?
5. Compare the arbors of the different Indian tribes. Why were they so unlike?
6. How and by what routes did the Indians come to Nebraska?
7. What has become of Nebraska's Indians?
8. What is an Indian Reservation? An Indian Agent? An Agency?
9. Why did Lewis and Clark ascend the Missouri?
10. In what did the early trade with the Indians consist?
11. For what purpose did the first white men come to Nebraska Territory, and by what routes?
12. Why were the overland routes so named?
13. What attracted emigrants to the far west?
14. What did the freighters haul? Why did they draw three wagons together as we see them in figure 67?
15. Who slaughtered the more buffaloes, the Indians or the white men?
16. Did the buffalo assist in the development of the west?
17. Why was our state settled first in the east? In valleys?
18. Why were most sod houses located on the upland?

19. Was it a good policy for the government to give settlers free homesteads?

20. What improvements do we now have which the settlers did not have?

21. Why were Indians unfriendly at times to settlers and emigrants?

22. Has the change from the buffalo to cattle been for the best?

23. How did the Platte Valley govern the location of the Union Pacific railroad?

24. Why did railroads wish to build westward across Nebraska?

25. Why was Nebraska settled by periods?

26. Why were cattle men opposed to settlement?

27. What is meant by the terms-; arid, sub-humid and humid?

28. How do schools influnce the development of our state?

29. Why is agricultural education so prominent in Nebraska?

30. Explain why counties are smaller in the eastern than in the western part of the state.

CHAPTER XIII

SUMMARY OF RESOURCES AND INDUSTRIES

Nebraska has a variety of resources upon which are based many industries.

Water Resources. The ground water is of great importance.[1] In Chapter VI we learned something of its forms and uses. The average good quality of well water is an important resource, one not capable of a monetary estimate. The uses of artesian waters, except for irrigation (Figure 80), have been named. Springs were also described.

The stream water is used for mill power most extensively in the eastern part of the state. In all there are over 200 water powers, many of them operating all the year. At present only a small part of the total fall of the streams is employed for power.

Ice is cut from a number of rivers and lakes, some of which are near Lincoln, Ashland, Deerfield and Valentine. This ice is placed in ice houses and used by railroads and large packing houses, as well as for domestic purposes.

Mineral Resources. Only traces of gold and silver have been found, while iron is not present in large enough quantities to insure profitable working.[2] The state's greatest deficiency is in its apparent lack of mineral fuel, no large quantities of coal being discovered, though thin beds have been worked at Ponca, Peru, Rulo, Humboldt and other places. A bed of a good quality of coal has been discovered near Peru which promises to develop into a paying mine. It is not known definitely whether or not there is much oil or gas in the rock formations. Building materials of several kinds are found in the state. The deficiency in fuel is a great drawback to the industrial development of Nebraska. If fuels were present in large quantities, our clay and cement materials could be manufactured more profitably into needed products.

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[1] Use references already cited, i. e. the Water Supply and Professional Papers. Also Camp Clark and Scotts Bluff folios.

[2] Barbour, E H. Nebraska Geol. Survey, Vol. 1, pp. 178-232.

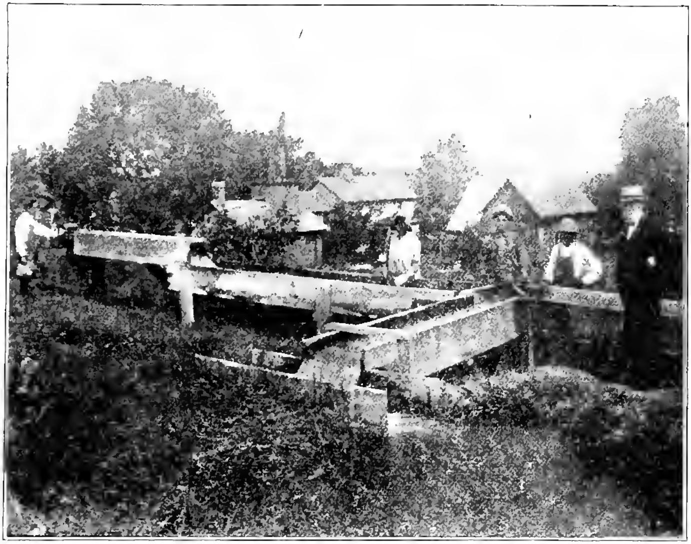

FIG. 80. ARTESIAN WELL OF THE SCHOOL FOR INDIAN BOYS AND GIRLS, SANTEE, NEBRASKA. TWO INDIAN BOYS AND AN INDIAN GIRL SHOW IN THIS FIGURE

Stone Working. Building stone is quarried in most counties, several kinds of rock outcropping in the different valleys. At such places the overlying rock waste is removed, after which the ledges are worked out as quarries. In Jefferson, Thayer, Cass and other counties, there are places where to

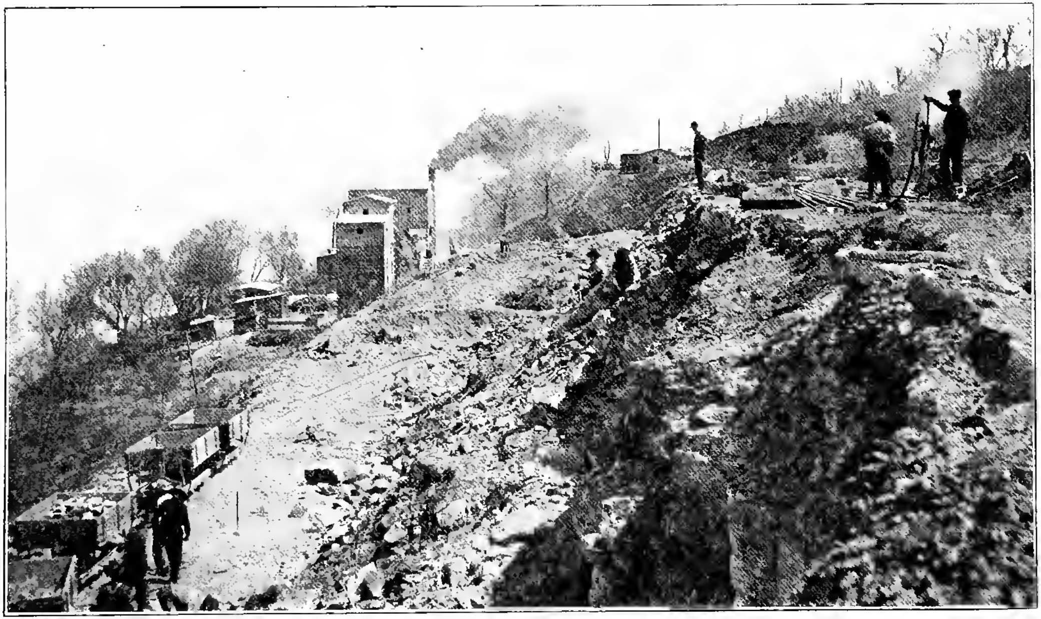

Fig. 81. National Stone Company's Quarry and Crusher near Louisville. The Face of the Rock Ledge, over 20 Feet High, has just been blasted down. A Steam Drill is operating above and to the Right. Only a Part of this Large Quarry shows in the Picture

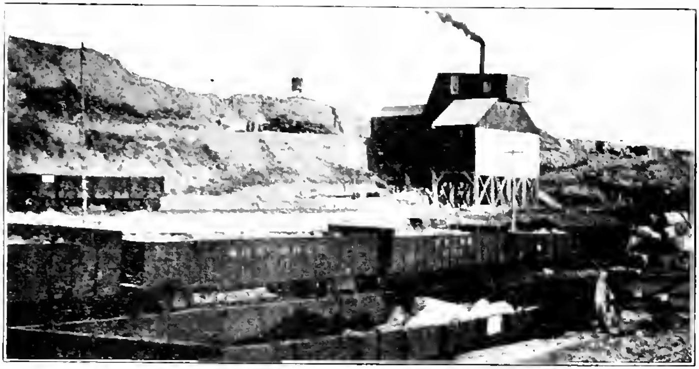

Fig. 82. A Large Stone-crusher near Wymore. The Quarry is above the Crusher

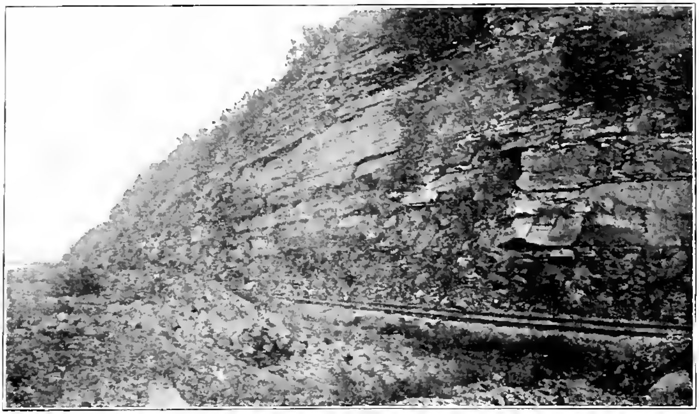

Fig. 83. Niobrara Chalk-rock forming High Bluffs near the Town of Niobrara. The North-western Railroad is at the Foot of the Bluff

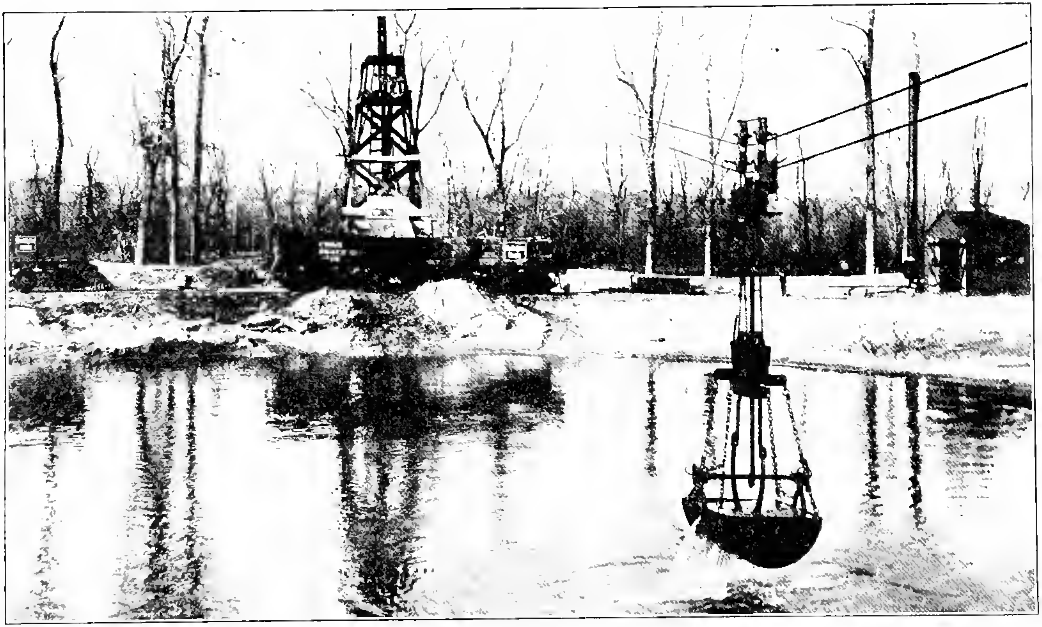

Fig. 84. A Large Clam Sand Dredge at Louisville. The Clam carries about One Ton of Sand at a Time and dumps it into the Car. The Lake is formed as the Sand is removed

trace the outcroppings of certain limestone formations would be to follow a continuous line of quarries. Unfortunately the stone does not compare in quality with that quarried in the leading stone producing states; however, it is of sufficient grade to warrant extensive use. Most of the quarrying is done near Louisville, Weeping Water, Nehawka, Johnson, Wymore and Gilead. Near Louisville the National Stone Company is operating one of the six largest quarries in the state (Figure 81), the product of which is used for foundation, ballast and concrete work. Two large quarries and crushers are operated two miles east of Wymore where 12 to 15 feet of limestone containing much flint is quarried and crushed for ballast,

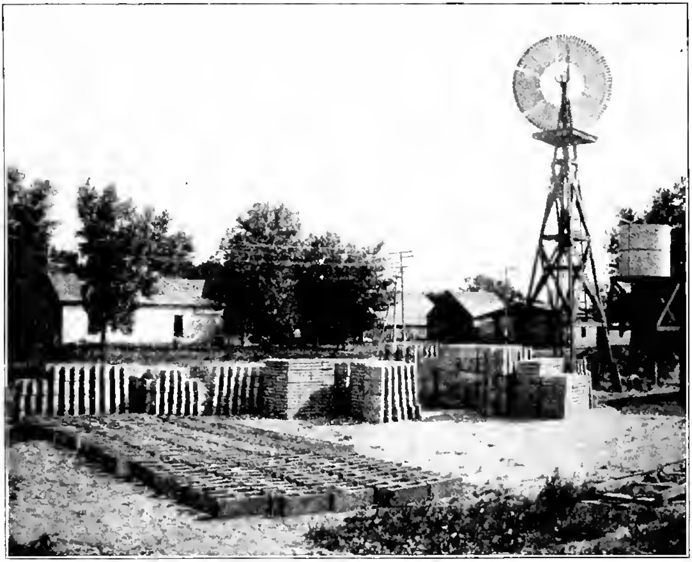

FIG. 85. ARTIFICIAL STONE PLANT AT CAMBRIDGE

concrete and street making. (Figure 82) There are fully 200 other quarries in the state operated for local use and shipment. The limestone used in the manufacture of beet sugar comes from the lower Platte Valley.

Cement Rock. Chalk and clay formations which may be used in the manufacture of Portland cement outcrop along the Missouri in the vicinity of Niobrara, and along the Republican from Superior to Alma. The same materials, the Niobrara chalk rock and the Pierre shale or clay, are quarried, crushed and manufactured into a high grade cement at Yankton, South Dakota.[3] This is done by heating pulverized materials together to a high temperature, then grinding them to a powder or cement. The chalk rock is shown prominently in the bluffs about one mile west of the town of Niobrara. (Figure 83) The carboniferous limestones and shales of southeastern Nebraska also are cement materials.

Clay Working. As a resource, clay holds an important place in our state, that obtained from the Dakota formation near Louisville, Lincoln, Beatrice, Fairbury and Steele City being well adapted to brick making, especially when mixed with loess. Pennsylvanian clays are manufactured into brick at Table Rock, Nebraska City, Peru and a number of other southeastern towns. Loess and alluvium are used alone in brick making where the older formations do not outcrop.

Nebraska has more than 100 brick yards, those most successfully operated being in the eastern counties. At some of the places expensive machinery is employed and a high-grade product is made, certain plants or yards manufacturing as many as five and ten million brick per year.

Sand and Gravel Working. These may prove to be our leading mineral industries. There is an abundance of sand

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[3] Condra, G. E. Geology and Water Resources of Northeastern Nebraska (in press) U. S. G. S

and a considerable amount of gravel, glacial and alluvial sands having a wide distribution[4]. The first-named is most abundant in the vicinity of Fairbury, while the alluvial sands are found in the valley bottoms, especially along the Platte. Often in the central towns of the state, such as Kearney and Grand Island, enough sand is taken from a cellar for use in finishing the structure. Nine different clam dredges are now loading the Platte sand on cars for shipment. (Figure 84)

The daily amount of sand shipped from each dredge varies from six to fifteen cars, making in all about three trainloads a day, when the loading is operating at its best. Much of the sand is shipped out of the state, going as far east as Des Moines, Iowa. Besides the dredged sand, the amount loaded by scraper and shovel is quite large. There are over 500 small sand pits in the state supplying local trade. Some of the principal uses of sand are for bedding cars, plaster, masonry, street making, and for the manufacture of artificial stone. (Figure 85)

Gravel for roofing is obtained in Cass and Sarpy counties, and for ballast in Jefferson, Knox, Holt, and Cheyenne counties.

Agricultural Resources. The state has four soil areas which correspond closely with the topographic regions. They are the Loess, Sand Hill, High Plains and the Bad Land regions. The soils vary in kind at different levels in the larger valleys, owing to the different kinds of rock which outcrop there; the soils being weathered rock mixed with humus which is formed from plants. This arrangement of soils in the valleys gives what is called belted soils. (Figure 86) A valley farm may have alluvial, clayey and stony soils on it, each kind extending parallel with the valley.

As the conditions of soil and water vary from place to place, so the forms of agriculture also vary. However, the positions of the crop belts seem to be determined more by the distribution of rainfall than by any other condition.

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[4] Condra, G. E., Part 3 of Vol. 3, Nebraska Geol. Survey (in preparation).

The ranches and farms are usually large and profitably worked, the first named often containing thousands of acres and the last hundreds of acres. Broad agricultural views are the order throughout the agricultural section. (Figure 87) The most fertile soils of the state are in the Loess Region, yet the cultivable lands of each soil area are readily tilled and usually quite rich in plant food. These conditions of soil assist in causing Nebraska's high rank in agriculture, the main forms of which are briefly described in this chapter.[5]

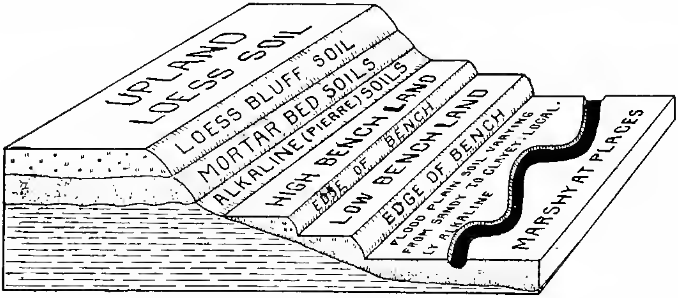

FIG. 86. IDEAL SECTION SHOWING BELTED DISTRIBUTION OF SOILS IN THE REPUBLICAN VALLEY, RED WILLOW COUNTY

Stock Raising. Nebraska ranks high in the production of live stock, the total value of which was about $150,000,000 in 1906. In order of their importance the live stock are cattle, horses and mules, hogs and sheep. These are raised mostly on

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[5] Farmers' Bulletins, over two hundred in number, may be obtained from the Secretary of Agriculture, Washington. They treat a variety of agricultural subjects in brief and are among the best student references.

The annual reports of the Nebraska State Board of Agriculture, the Nebraska Dairymen's Association and the Nebraska Horticultural Society should be accessible. Also the Agricultural Experiment Station Bulletins, University of Nebraska, Lincoln, and Bulletins on Soil, and the Year Books, Department of Agriculture, Washington, D. C. The Year Book can be obtained through Congressmen.

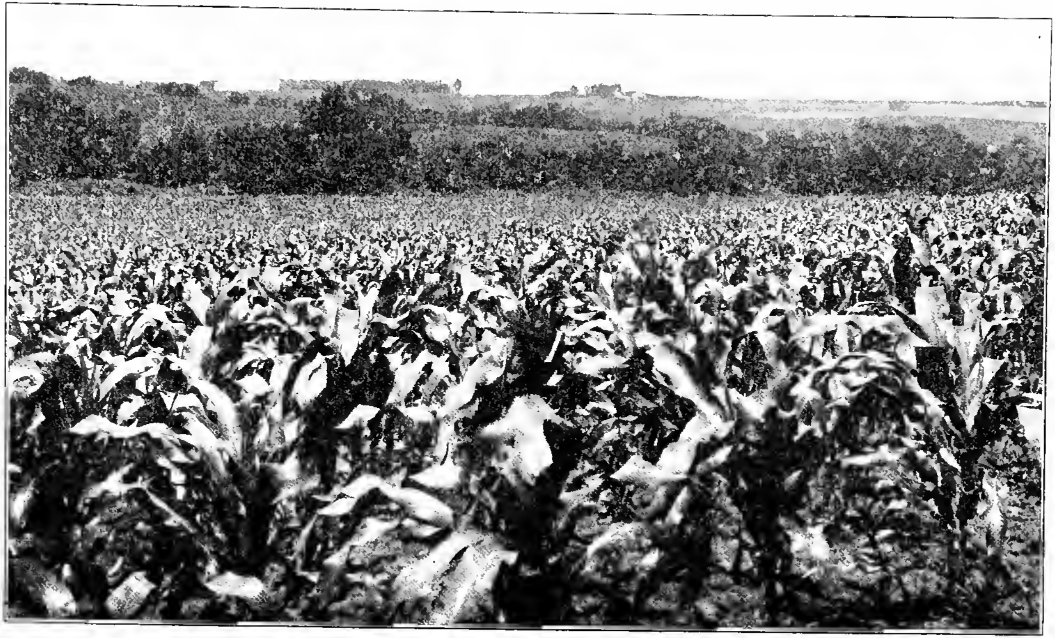

Fig. 87. A Broad Agricultural View along the Union Pacific in the Platte Valley

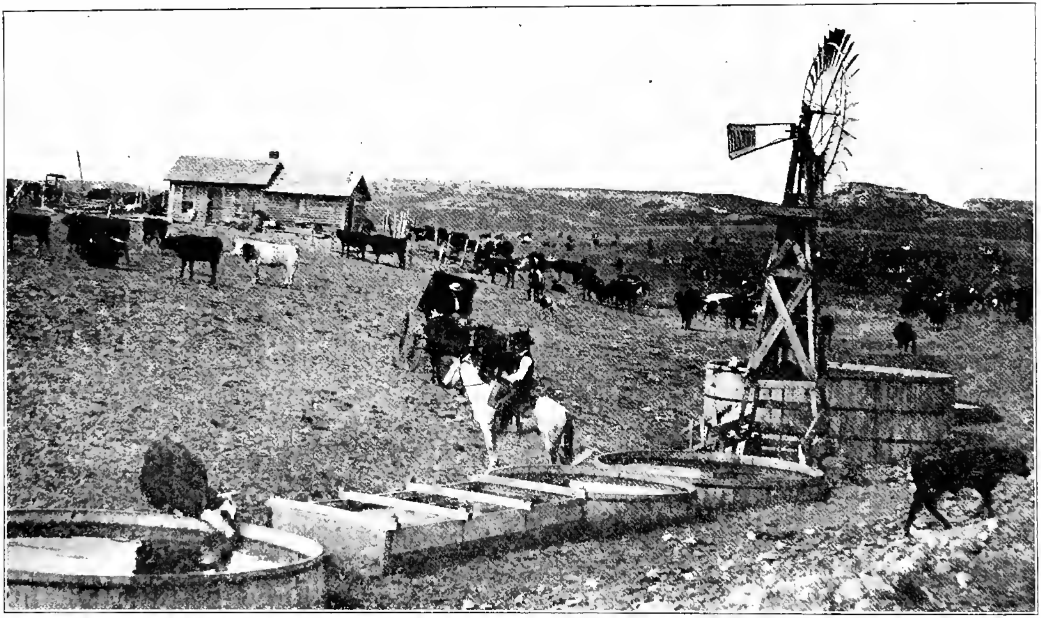

FIG. 88. A CATTLE RANCH IN WESTERN NEBRASKA
Photo by H A Mark

ranches which vary much in size and management. Few animals are raised on a small ranch, but they are given good care by their owner who usually lives in a small house surrounded by few improvemets. Saddle horses are used with which to drive and herd the cattle. Formerly, when the country was not fenced and the range was free, stock ran more at large. They are now grazed in pastures, yet the demand for good horsemanship has not entirely disappeared in the grazing districts of western Nebraska. The owners of large ranches employ riders who look after fences and the care of stock. On many of these ranches are well-improved homes.

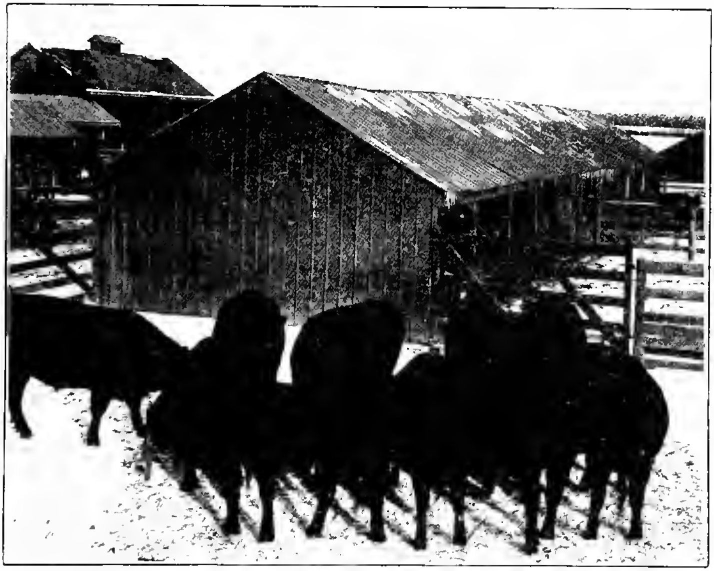

FIG. 89. TWO YEAR OLD STEERS IN FEEDING AT THE NEBRASKA EXPERIMENT STATION
Photo by U. G. Cornell

The western part of the state is often called "the cattle country". (Figure 88) There the native grasses, though usually short or thin, serve as a basis for stock raising on the ranches. The grasses are very nutritious, curing on the sod in the fall and forming winter pasture. In many places very little prepared food is supplied to horses and cattle during the winter season. The stock is allowed to "rustle", except when the snow is on, thus decreasing the need for forage and grain.

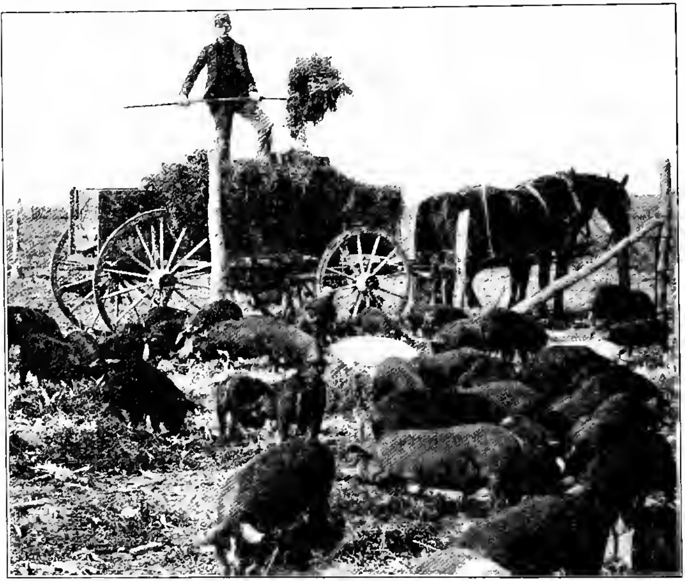

FIG. 90. FEEDING HOGS ALFALFA IN THE PLATTE VALLEY
Photo by H. A. Mark

The amount of free range has decreased, but the grade of cattle has improved, some of the finest herds now being found in the sand hills. Many cattle are shipped to the grass country and pastured there during the grazing season and later shipped

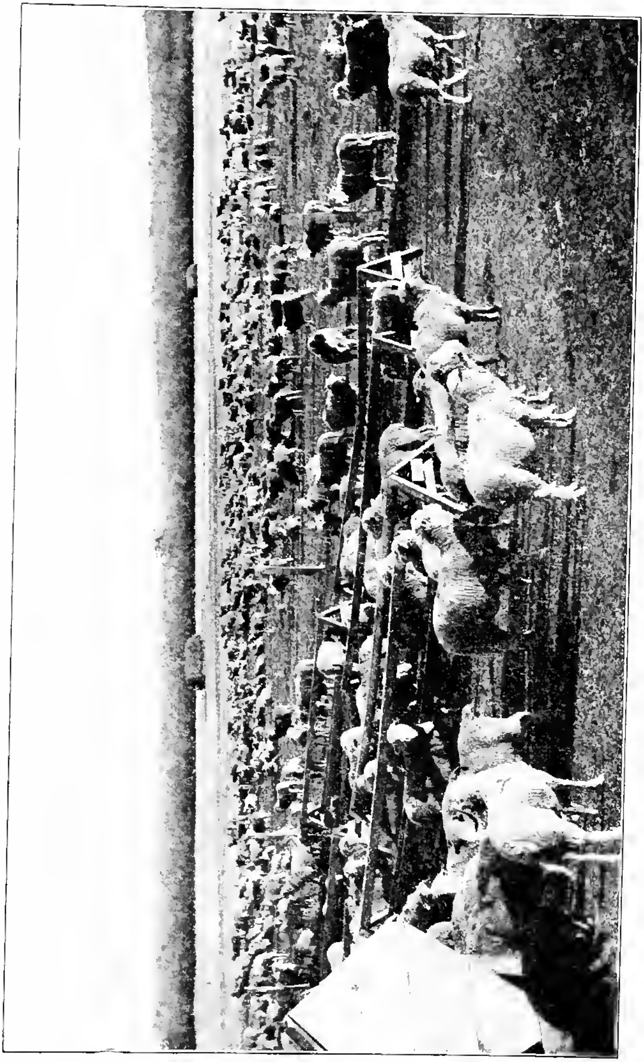

FIG. 91. SHEEP FEEDING NEAR HUMBOLDT

to the feed yards in the corn country and fattened for market. (Figure 89) So the stock feeding industry has considerable importance. The feed yards at Central City are the largest of their kind in the United States, over 20,000 cattle having been fed at those yards at one time. The feed yards show the relation of our grazing industries to corn raising. Besides this, many thousands of sheep are shipped to Nebraska from western and northwestern states and fed here for market on alfalfa, sugar beet pulp, hay and grain. Hogs are raised in large numbers on alfalfa, then fed a small amount of grain to finish them for market. In some cases they are shipped from alfalfa pastures to market without grain feeding.

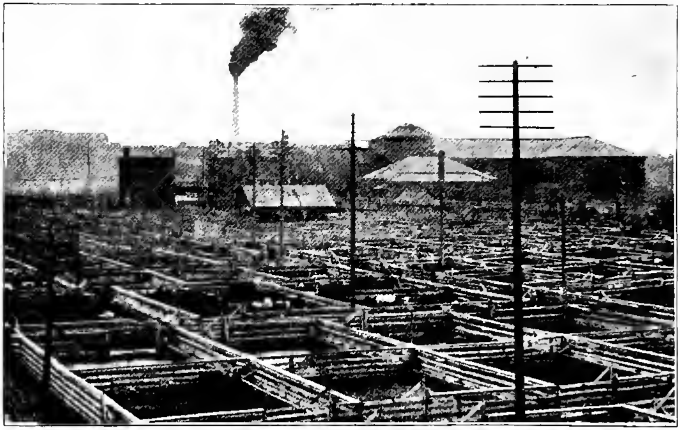

FIG. 92. SOUTH OMAHA STOCK YARDS IN THE AFTERNOON WHEN FEW CATTLE ARE IN THE YARDS

Though cattle raising is not confined to one region of the state, we may say that their feeding for market has its greatest importance within the corn belt. The hog belt has moved westward with alfalfa. (Figure 90) Few sheep are raised in Nebraska, though larger numbers are shipped in for feeding.

(Figure 91) Horses and mules are raised for road farm, dray and speed purposes.

Our cattle, hogs and sheep are shipped finally to the stock yards at South Omaha, Chicago, Sioux City, St. Joseph, Kansas City or Denver, where they are sold to packers and either slaughtered or exported "on the hoof". The South Omaha yards and packing houses are among the largest in the world. (Figure 92) Many products are manufactured from each animal, some of them going back to the ranches and farms.

Dairying. This industry has grown rapidly with the introduction of hand separators which make it possible to put the milk into marketable condition. Cream is separated on many ranches and farms and hauled in cans to shipping stations from whence it is taken regularly to centrally located creameries, the largest of which is at Lincoln. Railroad facilities are mostly favorable to the development of the dairy industry. Other helpful influences are cheap feed, pure water and good wagon roads. The industry is further promoted by instruction in the dairy school at the State University. The dairy herds are being improved and more care is given them now than formerly. (Figure 93) Many large dairy barns are scattered through the state.

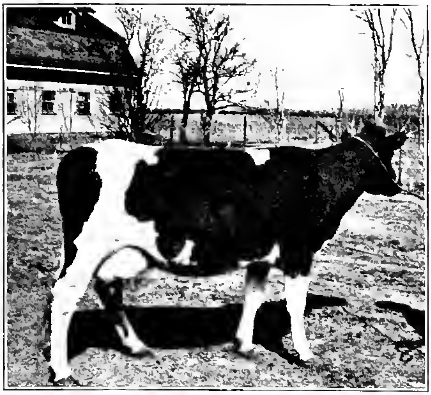

FIG. 93. DAIRY COW AND A MODERN DAIRY BARN AT EXPERIMENT STATION, UNIVERSITY OF NEBRASKA, LINCOLN
Photo by U. G. Cornell

FIG. 94. CHICKENS, DUCKS AND TURKEYS IN WESTERN NEBRASKA
Photo by H. A. Mark

FIG. 95. LARGE CORN RAISED ON THE MISSOURI RIVER BOTTOM NEAR PERU

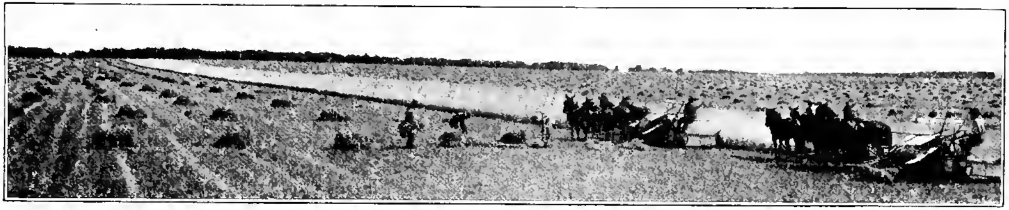

Fig. 96. Wheat and Oats in Eastern Nebraska, near Verdon
Photo by U. G. Cornell

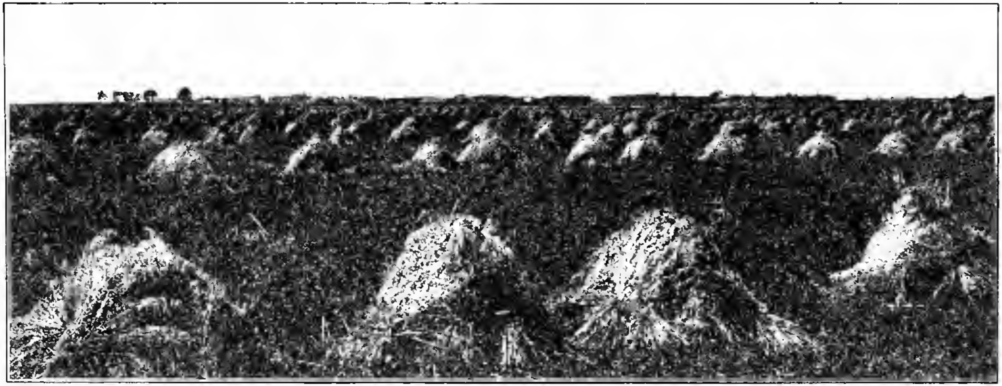

Fig. 97. Oats and Wheat in Central Nebraska, near Fairmont. A Typical Farm Scene on the Loess Plains

The production of cheese is small, the air being too warm and dry in our state, this industry doing best in moist northern countries.

Poultry Raising. Conditions in Nebraska are favorable to the profitable pursuit of this industry. There is an abundance of natural food, while the climate and drainage conditions insure the health of fowls and their rapid growth at small expense. (Figure 94.) Chickens are raised on nearly all farms and ranches, while turkeys, ducks and geese are found in smaller numbers and at fewer places. Poultry and eggs constitute an important part of our food; they are shipped in large quantities to other states, both east and west. The packing houses at South Omaha do a large business in poultry and eggs. The birds are fattened in about two weeks at the packing houses, then slaughtered and exported. Chicken feeding has become a recognized industry.

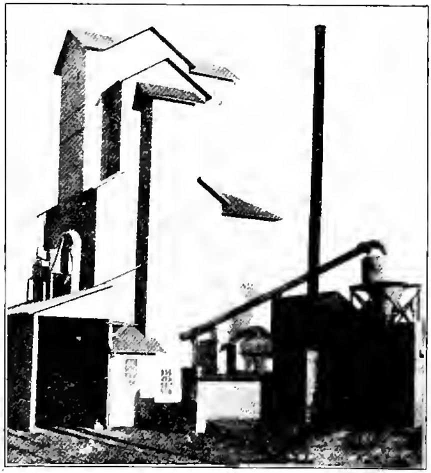

FIG. 98. GRAIN ELEVATOR AT ASHLAND

Grain Crops. Corn, wheat, oats, barley and rye are the principal cereals cultivated.[6] The eastern part of the state lies in the great corn belt (Figure 95), but in the western part

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[6] The Bulletins of the Agricultural Experiment Station of Nebraska may be obtained by writing the Director of the Experiment Station at Lincoln.

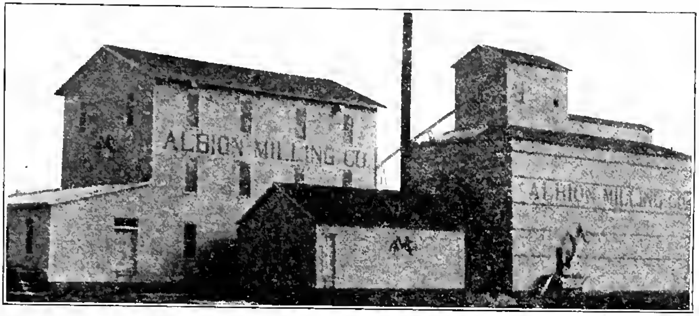

FIG. 99. FLOURING MILL AT ALBION

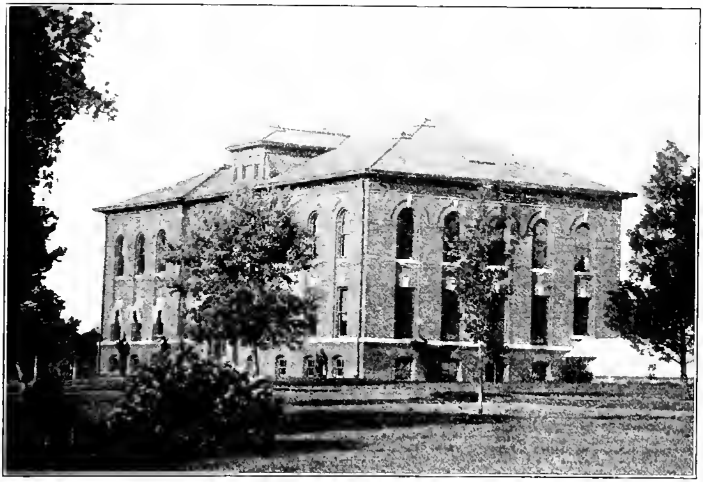

FIG. 100. ONE OF THE BUILDINGS AT THE NEBRASKA EXPERIMENT STATION, WHERE CROPS ARE STUDIED AND STUDENTS ARE TAUGHT AGRICULTURE

Photo by U. G. Cornell

the rainfall is too light for corn production according to the present methods of cultivation. Wheat and similar small grains mature at the close of the season of greatest moisture, hence they do well farther west than corn, which does not finish its growth until later in the year. Then the growing season, free from frosts, is shorter to the west.

Each of the principal grain crops grows well in the Loess Region from the eastern (Figure 96) to somewhat beyond the central (Figure 97) part of the state, giving opportunity for diversified farming and the rotation of crops. It is here that one may see many well-kept farm buildings surrounded by orchards, groves, feed lots, pastures, hay land and fields of grain. These are farms and farm homes.

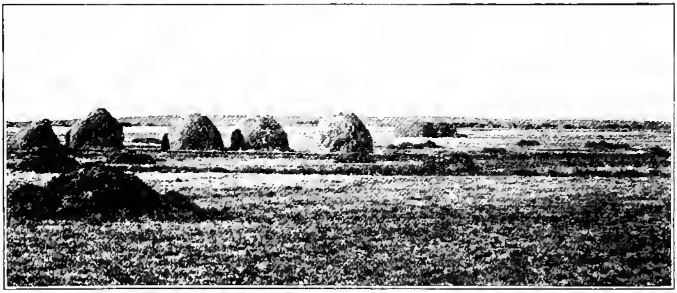

FIG. 101. ALFALFA SCENE IN THE NORTH PLATTE VALLEY
Photo by H. A. Mark

Winter wheat is an important crop in the southern and southeastern counties, while spring wheat and barley are raised in the northern and western parts of the state. The oat crop is generally rotated with corn and wheat. The decrease in rainfall at harvest time makes it possible for farmers to save most of each crop. Much of the corn is fed to live stock, while most of the wheat, after cleaning in elevators here (Figure 98), is shipped to Omaha, Minneapolis and Kansas City. There are many flour and grist mills in Nebraska and the amount of grain which they grind seems to be increasing. (Figure 99) The value of the grain crops is about $125,000,000 a year.

FIG. 102. TREES IN BLOOM IN THE HARTLEY ORCHARD, NEAR LINCOLN

Investigations carried on at the Nebraska Experiment Station at the University of Nebraska (Figure 100) have resulted in the introduction of varieties of wheat and oats which grow well in the dryer regions of the state. By this means yields have been increased and the grain belts enlarged. The yield of corn per acre is increasing, due to careful seed selection and to improvements in cultivation.

Hay and Forage Crops. In Rock and Holt counties large quantities of wild hay are cut, baled and shipped. This product is of importance throughout the state, the bottom lands yielding most of the supply. Alfalfa, our greatest hay and forage crop (Figure 101), is now grown in every county of the state, producing from two to four cuttings each year. It grows best under irrigation where the soil is deep, loamy and smooth, yet

FIG. 103. MAKING CIDER IN EASTERN NEBRASKA

large crops are produced without irrigation along the Platte and Republican valleys where the water table is not too close to the surface. It is also grown on the uplands. After a good stand has been secured, the plant resists drouth and freezing and needs little or no cultivation. It makes good stock feed, being highly nutritious. On some of the dryer lands less valuable forage crops are raised for rough winter feed for stock. The hay and forage crops rank next to wheat in value.

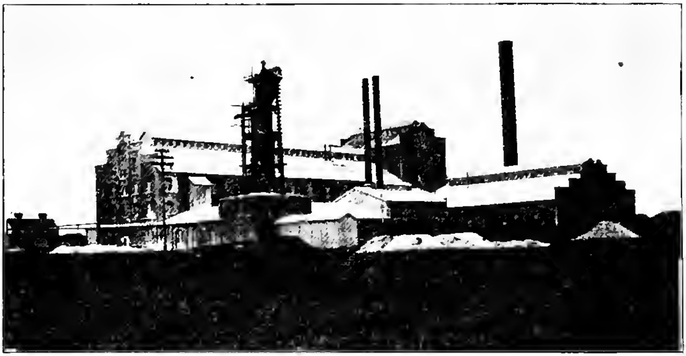

FIG. 104. BEET SUGAR FACTORY AT LEAVITT, NEAR FREMONT

Fruit Raising. Wild fruits of several kinds do well on the more broken lands of each topographic region. Some of our soils are adapted to peaches, plums, cherries, grapes, strawberries and apples, and in many localities these and other fruits are raised for local use. Commercial orcharding is an important pursuit at several places, where peach, apple (Figures 102 and 103) and cherry orchards cover entire farms. The most extensive orcharding is carried on near Nehawka, Falls City, Lincoln, Valley, Blair, Wymore, Kearney, Beaver City and McCook.

Sugar Beets and Beet Sugar. The acreage of sugar beets is increasing. Nebraska now has two large beet sugar factories, one at Grand Island and the other at Leavitt, a station near Fremont.

The loose, smooth bench land soils of the Platte, Republican and Elkhorn valleys are well suited to the cultivation and growth of sugar beets. The best results are now obtained under irrigation in the subhumid region where the sunshine is greatest.

Fig. 105. Potato Field near Holdrege

The crop is grown at a number of places and shipped to the beet sugar factories (Figure 104), the processes in the making of beet sugar being rather difficult to understand. The factories run from the time the beets begin to arrive in the fall until about the first of February, the time during which they operate being called the "campaign". The beets are weighed, cleaned and cut into small bits. Their juice is then extracted and made into sugar of commercial form. Russians and Germans, from long familiarity with beet culture in the old country, are the laborers usually employed in the western beetfields.

Specialized Farming. Vegetable gardening is practiced quite extensively near some of the larger cities. Celery is grown near Kearney, Central City and Hebron, while popcorn is an important product at North Loup and a few other localities in the northern and northeastern parts of the state. Garden seeds are raised extensively at Lincoln, Ashland and other points, and sugar corn is grown largely for canning purposes.

Potatoes for home use are now grown in every county of the state, and as a farm crop in the northwestern and western counties. (Figures 105 & 106) Many car loads are shipped each year from Beaver Crossing, Scotts Bluff, Hemingford, Chadron, Rushville and Gordon.

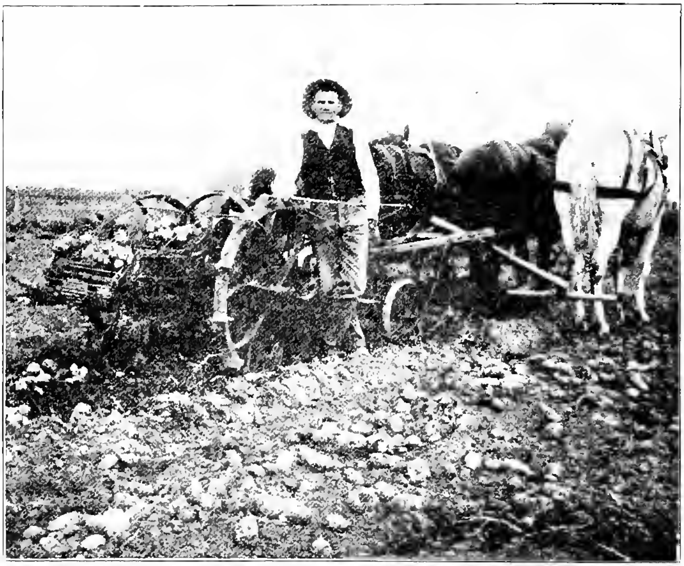

FIG. 106. HARVESTING POTATOES IN WESTERN NEBRASKA. PHOTO BY H. A. MARK

QUESTIONS AND EXERCISES

1. What is a resource? An industry?

2. Which is the more important resource, good water or good soil?

3. Why is much ice put up in Nebraska?

4. Why are most stone quarries in valleys?

5. What qualities are necessary in good building-stone?

6. What is a "dredge" and why is the dredge shown in Figure 84 called a clam dredge?

7. How many and what uses are made of sand in your vicinity?

8. Why is "artificial stone" so named? How is it made?

9. How is the humus of soil formed?

10. What kinds of soil are found near your school?

11. Make a collection of the principal kinds of soil near your home.

12. What is forage? Name the principal kinds of forage produced and used in your vicinity.

13. Why are cattle raised in one part of Nebraska and fitted for market in another part?

14. Give two reasons why sheep raised in Montana and Wyoming are fattened for market in Nebraska.

15. Make a list of products obtained from cattle.

16. Many farmers sell their live stock "on the hoof" and then buy the products manufactured from them, for use in their homes. Why is this done?

17. What is meant by a "corn belt"? A "wheat belt"? By what means are these belts being extended in Nebraska?

18. Where in Nebraska are the most apples grown? Peaches? Plums? Cherries? Strawberries?

19. What conditions of soil and climate are most favorable for the cultivation of sugar beets?

20. Why is potato raising so extensively carried on in western Nebraska?

21. What is meant by "specialized farming"?

22. What is Nebraska's most important resource? Industry?

23. What industry is being developed most rapidly?

CHAPTER XIV

METHODS OF RECLAMATION

Reclamation is an important factor in geography, as it makes otherwise worthless lands valuable. Much of the arable land of our state is now farmed extensively, including soils which were once regarded as unfit for the production of farm crops, being dry, wet or sandy.

The principal methods now employed in Nebraska for the improvement or reclamation of soils deficient in the ways just named are described in this chapter.

Irrigation. Most of us have seen irrigation practiced in some form. It is the application of water to the soil and crops by artificial means and is employed usually in dry countries or in countries with dry seasons. Irrigation in Nebraska is largely in the sub-humid or western part, yet in every county it is used to some extent, though not always profitably.[1] The water is obtained principally from rivers, also from shallow wells, artesian wells, springs and ponds or lakes. Lawns and small gardens are irrigated by hose and spray. But the water applied to large fields flows from rivers through ditches or canals and their laterals to the land to be irrigated. The ditches are made large or small and long or short, depending upon the supply of water and the amount of land to be reclaimed. Since the air of western Nebraska is dry, evaporation is excessive, and successful irrigation requires an abundance of water. Certain ditches constructed without regard to the water supply are of no use during the irrigation season because of a lack of water. The surest irrigation from small streams is near their head waters. Irrigation along rivers is confined mostly to their valleys, because of the nearness to water and of the presence of bench lands there which are easily irrigated. (Figure 107) Irrigation from wells is employed on both the bottom and the uplands, but less extensively than from rivers.

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[1] References in Water Supply Papers and Professional Papers, 17 and 32 U. S. G. S.

The government is constructing a large dam, The Pathfinder, across the North Platte River in Wyoming to hold back the natural flow of the stream in the springtime. This impounded water will be sufficient to irrigate much of the upland in addition to that in the valley. The canals are large and long, extending into Nebraska.

Much land along the North Platte in western Nebraska is now profitably irrigated. At places most of the bench and bottom lands are under ditch, growing principally alfalfa, wheat and oats where formerly was only grazing land. The water supply of the South Platte, Niobrara, Lodge Pole and Republican rivers is scant and uncertain during summer, consequently this method of reclamation is not carried on extensively from those streams.

Just how much of the state's dry land may be reclaimed for agriculture by irrigation is not known. It will not be possible however, to irrigate a very large part of the High Plains, as the water supply is limited.

Drainage. This is the opposite of irrigation. Along the Big Nemaha, Missouri, Platte and Elkhorn valleys certain bottom lands which once were covered with marshes and lakes have been drained and reclaimed for grain growing. A long ditch in Burt County will drain several thousand acres of Missouri bottom land and thus reclaim it for farming purposes. Numerous ditches near Falls City and Rulo, Richardson County, carry the flood water from fields formerly devoted to

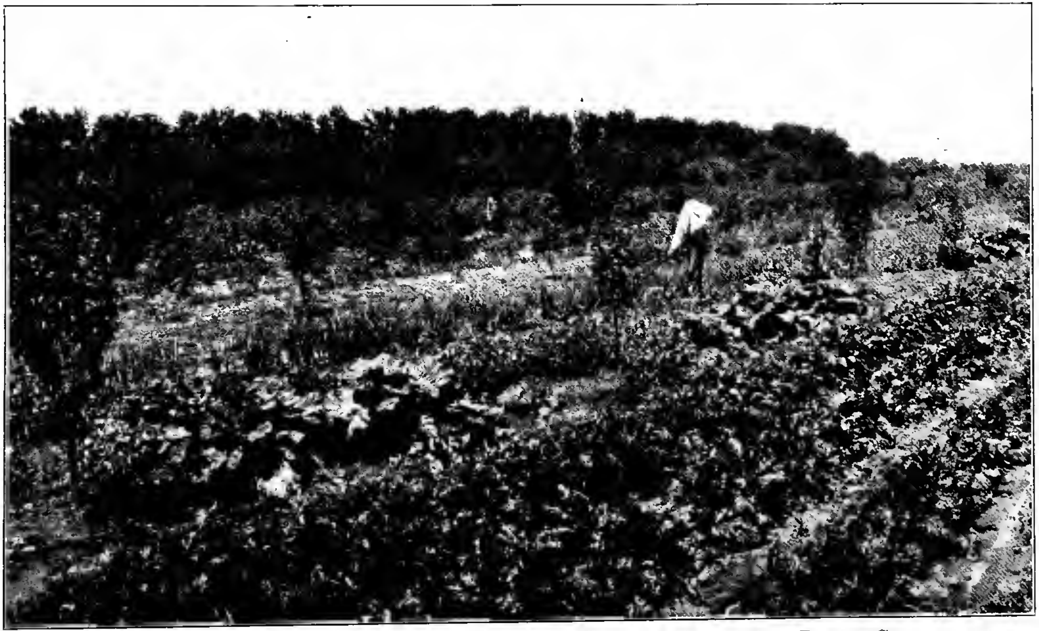

FIG. 107. A GENERAL IRRIGATION SCENE ALONG THE REPUBLICAN, IN DUNDY COUNTY

FIG. 108. COTTON-WOOD GROVE AT FREMONT

grazing. In all, many thousand acres of land can be improved by drainage.

In the lake region of the sand hills south of Valentine, ranch owners have proposed to lower the water in certain basins and valleys by draining them northward through ditches to

Schlagle Canyon. This may make it possible to grow alfalfa where the valleys are now covered with water.

Forestation. This method of reclamation has been used in each region of the state. The first tree planting was on what were called tree or timber claims. Many of the trees thus planted were not adapted to the climate, neither were they properly cared for, being exposed to injury from prairie fires and to be browsed over by cattle. Consequently the tree claim attempts at forestation proved failures in most cases, at least when the object was to thereby receive title to government land

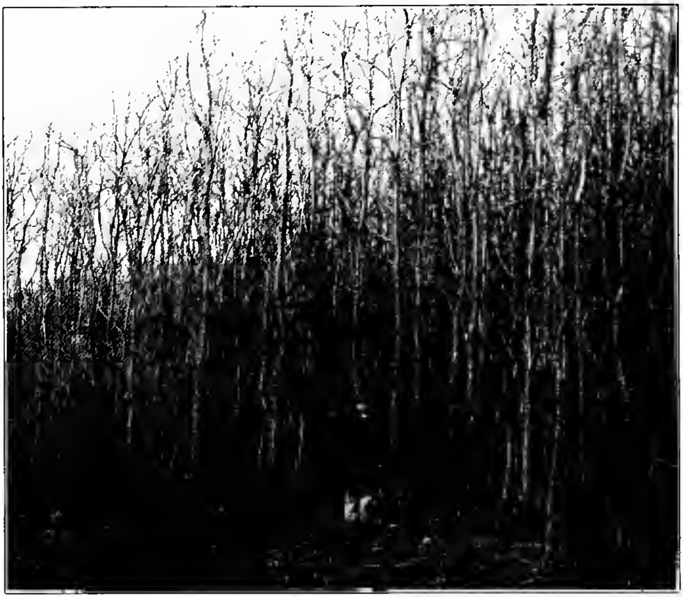

FIG. 109. CATALPA POST TIMBER NEAR PAWNEE CITY
Photo by Chas. A. Scott

Forestation proved most successful in the eastern and and central parts of the state, where we now have many large groves (Figure 108) and windbreaks which are a result of private planting. In some cases post timber has been grown with profit. (Figure 109)

It is now thought that forestation may become an important form of reclamation in the sand hills. In April, 1902, the Government established the Dismal River and the Niobrara forest reserves, the first containing 90,000 acres and the other 126,000 acres of sand hill land. (Figure 110.) At the same time the North Platte Reserve was set aside with 342,000 acres of similar land. There is good evidence that pines and cedars may be grown in the sand hills. Such trees occur here and there in the region, but the most favorable evidence in this region is found on the Bruner ranch, where a beautiful grove of pines was planted about fourteen years ago. (Figure 111)

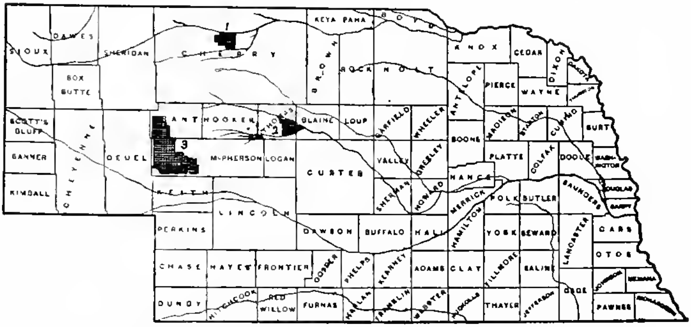

FIG. 110. THE NEBRASKA FOREST RESERVES: 1, THE NIOBRARA; 2, DISMAL RIVER; AND 3, THE NORTH PLATTE FOREST RESERVE

The forester in charge of the Nebraska reserves superintends the raising and transplanting of millions of small pine seedlings.

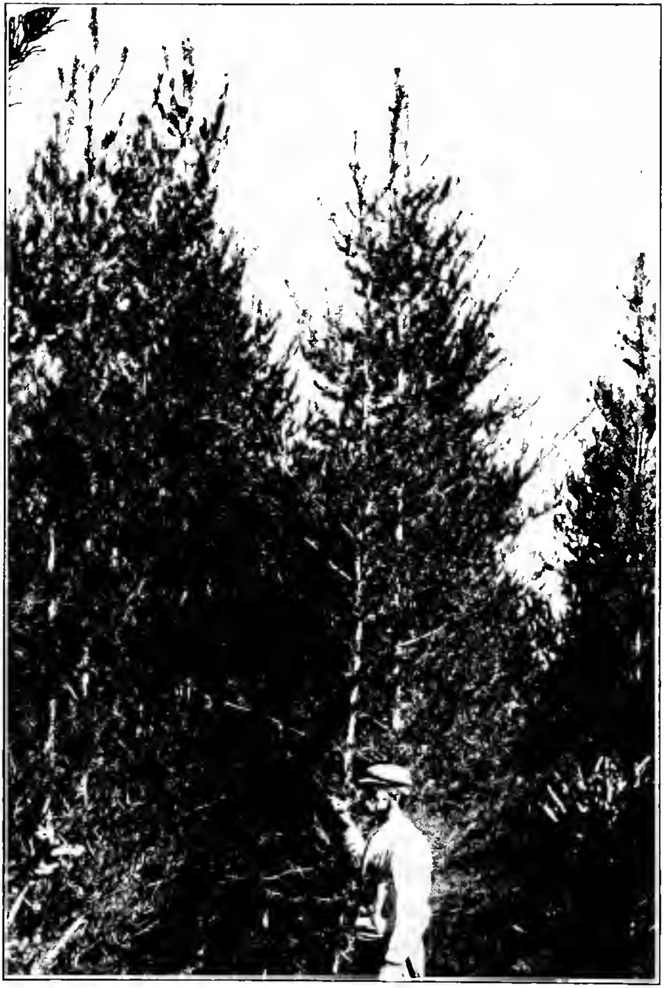

Fig. 111. Pines on the Bruner Ranch, Holt County
Photo by R. A. Emerson

They are raised in seedbeds (Figures 112-113) and transferred to the hills when two or three years old. Ranch owners in the Sand Hill Region, encouraged by the success of the planting on the reserves, are now putting out small private groves. In the year 1905, over 50,000 trees, on over 50 ranches, were thus planted.

If forestation of the sand hills proves successful our state will eventually have a valuable resource where once the land was regarded as waste. It will be a means of solving Nebraska's greatest need, that of fuel and lumber. Since the trees grow slowly it will take 15 years or more for them to become large enough for firewood and fully 100 years for use as saw timber.

As the sand hills become covered with trees we should expect a desirable change in the appearance of the landscape, also changes in the associated plant and animal life. The change will be from grass land life to timber land life.

Dry Farming. The best-known method of dry farming is the Campbell system. By this and similar methods moisture is stored in the soil and kept from evaporating freely into the air at dry times. This method of cultivation is not suited to really dry land, but to semi-arid conditions. Cultivation at the right times produces a mulch of loose soil which checks evaporation. (Figure 114) The moisture is kept from escaping freely into the air and caused to do its duty in the growth of crops. By what is called summer fallowing farmers conserve the rainfall of two years, raising a crop every other year. This method is practiced on the dryest lands, but it demands much labor. It is now a known fact, that certain drouth-resisting crops may be raised profitably on the High Plains, by methods of cultivation adapted to the rainfall and humidity, even when the mean annual rainfall is more than 15 inches.

Drouth Resisting Crops. In certain foreign countries, notably southern Russia, grain and forage crops have been

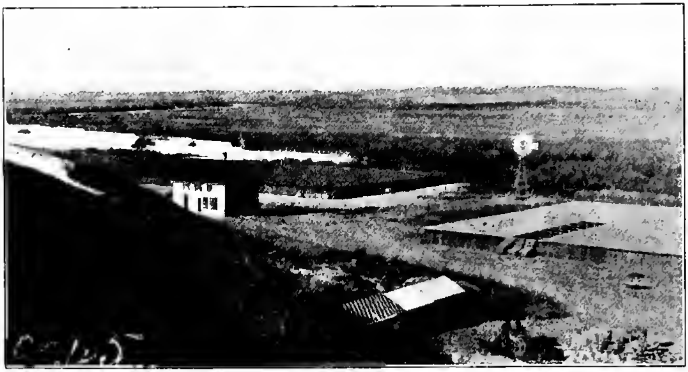

Fig. 112. General View of Seed Beds and Buildings at the Dismal River Forest Reserve, near Halsey

Photo by Chas. A. Scott

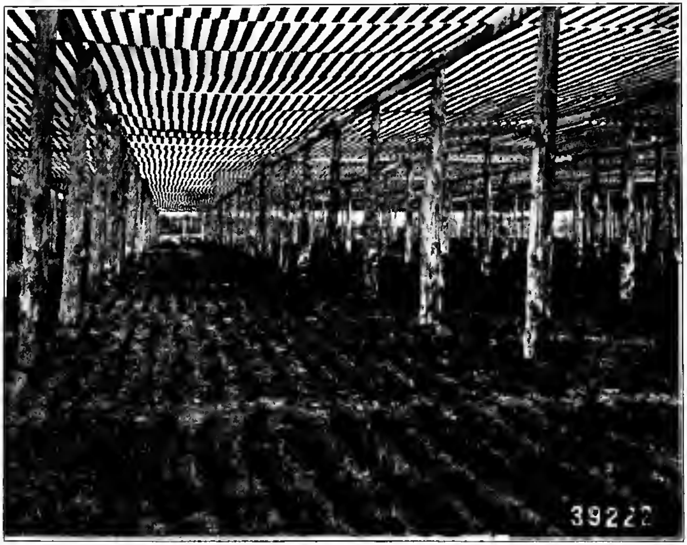

Fig. 113. Interior View of Seed Beds at Dismal River Forest Reserve, showing Small Pine Seedlings in Rows. The Roof-like Lath covering is to keep out a Part of the Sun Light

Photo by Chas. A. Scott

grown for ages, under practically the same conditions of soil and rainfall that are found in the dryest parts of Nebraska. The crops have become drouth-resisting. The seeds of a few of these plants were secured by the Nebraska Experiment Station a few years ago, and planted in western Nebraska with good results. Brome grass, Kherson oats, Macaroni wheat and Speltz, all drouth-resisting, were imported and their seed furnished to a number of farmers who have since grown the crops widely and profitably over the High Plains Region, but most successfully when cultivated by dry farming methods. Brome grass yields far more pasture than our native grasses of the sub-humid region. Macaroni wheat and

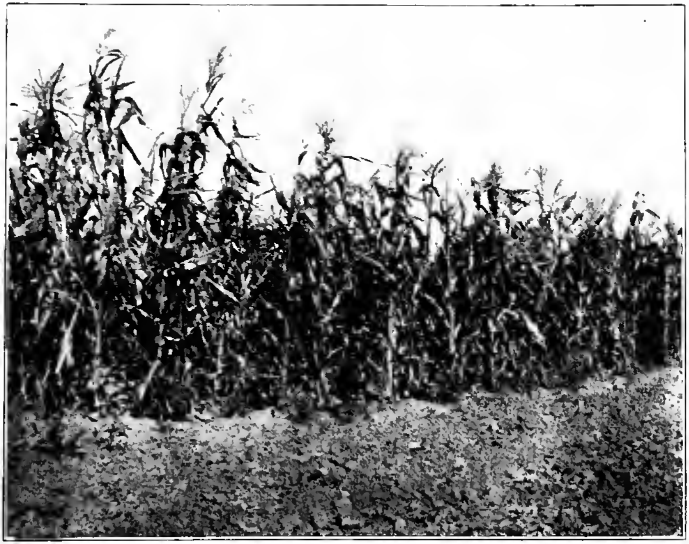

FIG. 114. CORN RAISED BY DRY FARMING METHODS IN WESTERN NEBRASKA. THE FOREGROUND HAS BEEN SUMMER FALLOWED

Kherson oats produce large crops where the rainfall is scant. The raising of drouth-resisting crops can be practiced over a large area of Nebraska, where grains accustomed to humid conditions do not thrive.

Alfalfa is usually regarded as a drouth-resisting plant, yet it grows best where there is an abundance of ground water. However certain dry land varieties of alfalfa are well adapted to the uplands of Nebraska, where the annual rainfall is between 15 and 20 inches.

QUESTIONS AND EXERCISES

1. What is reclamation, and what are its purposes?
2. Compare irrigation and drainage.
3. Have the Rocky Mountains anything to do with irrigation in Nebraska?
4. Where is irrigation the more successful, in a very dry, or in a subhumid region?
5. Why can't all of western Nebraska be irrigated?
6. Why did tree claim forestation fail?
7. If pines like the ones shown in Figure 111, can be grown in the sand hills, why have ranch men been slow to set out trees?
8. Why is dry farming so named? A drouth-resisting crop?
9. What is a mulch? Summer fallowing?
10. Are any drouth-resisting crops grown near your home? Do such crops grow well in eastern Nebraska?
11. Why is alfalfa called our greatest forage crop?
12. Give four reasons why central and western Nebraska should increase in population. Would such a development benefit Omaha and Lincoln? If so, how?

CHAPTER XV

CITIES AND TOWNS

A municipality with 1,500 people is called a city in Nebraska. The cities are grouped as first, second and third class, with divisions under each class, Omaha and Lincoln each forming a division of the first class.

Our cities and towns are places of business, of transportation, manufacture and trade. Schools, churches, a central park, and wide, well-kept streets parallel with the section lines are common to most of them.

Several reasons for their growth may be given. The largest places are in the eastern or oldest and richest part of the state. County seats usually grow faster than other towns in a county, and the location of a state or other important institution in a town becomes also a factor of growth. The presence of a railroad usually is favorable to growth and development, many of the oldest towns which did not become railroad points finally being abandoned. Division points on railroads have an advantage over other places. The topography[1] and water supply have to an extent determined the location and development of several cities and towns. There are no places of any size in the Bad Land and Sand Hill regions. A few towns on the High Plains give promise of considerable importance, but with few exceptions the cities of Nebraska are confined to the Loess Region.

Besides the influences just named we should note also that enterprising townsmen are a factor. The wide-awake places have been favored in the location of institutions, whether county, state, or of a private nature.

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[1] Study the topographic and hydrographic environs of the principal cities and towns, by means of the maps shown on Plate III. Where possible determine altitude, slope, drainage conditions, etc.

For the purpose of description, the cities and towns are grouped according to the drainage basins of the state. The population when given is based on the school census of 1905. The altitude is placed in a bracket, and usually is for the doorsill of the main railroad station.

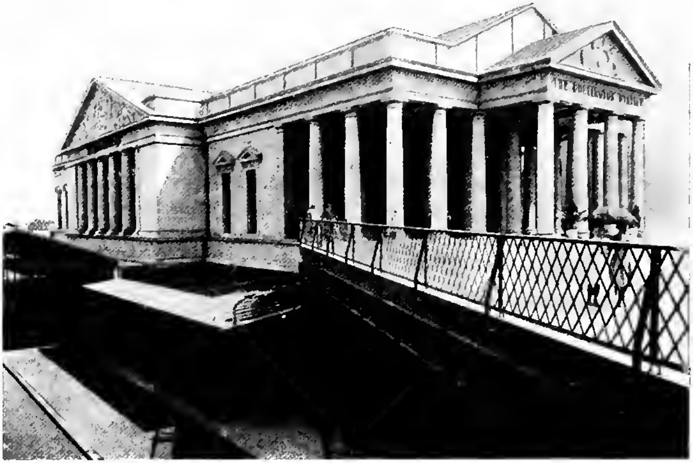

FIG. 115. BURLINGTON (C. B. & Q.) STATION AT OMAHA

Along the Missouri River. The oldest towns of our state are along this water way, the largest being where railroads, crossing the river, have division points on the Nebraska side. *Ponca* (1143), *Dakoto* (1102) and *Tekamah* (1060), are county seats with railroad and agricultural advantages.

Blair (1081), the county seat of Washington County, is favor-

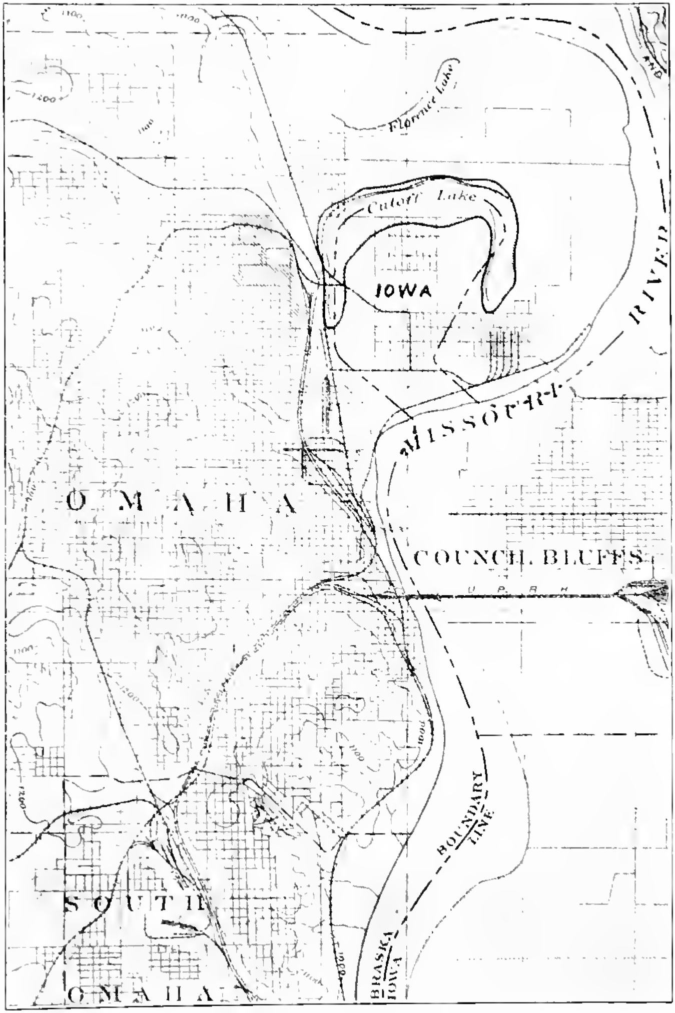

Plate IV. Outline Map of Omaha

ably located, overlooking the Missouri river. It has two railroads, one of which crosses the Missouri.

Omaha (1034), with a population of about 120,000, is the metropolis and only metropolitan city of Nebraska. (Plate IV) It has several trans-continental and a number of more local railroads, and the Omaha, Lincoln and Beatrice electric line. The Burlington (Figure 115) and the Union depots are very fine structures. The Platte Valley, a few miles west of the city, is easily reached by the principal railroads, making of Omaha the "gateway" city of Nebraska.

FIG. 116. NORTH WING OF OMAHA HIGH SCHOOL BUILDING

Omaha was laid out and made the Territorial capital in 1854. With the coming of the Union Pacific railroad, 1866-1869, the town secured a lasting advantage over other competing river points. Since that time it has grown rapidly, becoming a great railroad, manufacturing and wholesale center, and an important distributing point. The shipping and trade portions of the city are on the lower and smoother ground, and the residence districts on the higher land.

The city obtains an abundant and sure supply of good water from the Missouri. It is well drained, lying on the Missouri Valley slope between altitudes 1,000 and 1,175 feet. The improvements are extensive, there being a number of parks, over 85 miles of paved streets and about as many of street railways. Some of the principal buildings rank well with those of the largest eastern cities, the high school building being especially fine. (Figure 116) Omaha is headquarters for one department of the United States Army; it also is the seat of Creighton University (Catholic).

South Omaha (1124), with nearly 30,000 people, is the third city of Nebraska. It is an outgrowth of Omaha, and has large stock yards and packing houses where many thousands of cattle, swine, sheep and chickens are shipped each year from parts of Nebraska and adjacent states. The animals are slaughtered and turned into many products. The stock yards (Figure 92), packing houses and similar plants cover more than 300 acres, furnishing employment for several thousand men.

Bellevue (985) ten miles south of Omaha, is the seat of Bellevue College (Presbyterian). It is the oldest permanent town in our state.

Plattsmouth (968) the county seat and largest city in Cass county, is situated on a bold Missouri Valley slope near the mouth of the Platte River. It has two railroads, the Burlington and the Missouri Pacific, the former having a large bridge across the Missouri River. The city is the "gateway" to the lower Platte. Among its industries are machine shops, flouring mills, brick yards and cigar factories.

Nebraska City, one of the oldest, best known and largest cities of Nebraska, is the county seat of Otoe County. It was the home of Hon. J. Sterling Morton, the father of "Arbor Day." (Figure 117) The city has three railroads, one of which, the Burlington, crosses the river and connects with the Iowa and Missouri divisions of that system. Among the industries are stock yards, packing houses, brick yards, elevators, canning factories and a brewery. The surrounding country is rich agriculturally. The Nebraska Institute for the Blind is located here.

FIG. 117. VIEW IN ARBOR LODGE, NEBRASKA CITY
Photo by C. E. Dwyer

Peru (902) is about fourteen miles below Nebraska City.

Here the State Normal School has its beautiful and picturesque location overlooking the Missouri.

Rulo (842) is in the southeastern corner of the state where the Burlington railroad crosses the Missouri River.

There are several important and growing cities in the smaller tributary valleys of the Missouri. *Hartington* (1385), the county seat of Cedar County, *Weeping Water* (1075) in Cass County, and *Auburn* (1051), the county seat of Nemaha County, are the best known of these.

In the Big Nemaha Valley. *Falls City* (898) is the largest city in this group. It is the county seat of Richardson County and is on the Kansas City lines of the Burlington and the Missouri Pacific railroads. Located in a rich agricultural region and prominent in cattle and fruit shipping, it has good improvements, produce houses, flouring mills, large ice houses, a canning factory and one creamery.

Humboldt (982), *Table Rock* (1023), *Pawnee* (1175), and *Tecumseh* (1114) are in rich agricultural districts. Pawnee, the county seat of Pawnee County and Tecumseh, the county seat and largest place in Johnson County, each have two railroads.

In the Platte Drainage Basin. There are many growing places in this group, most of the towns and cities having their locations on alluvial terraces which afford good drainage and ideal positions, except where the river is building up its bed. By examining plates I and II we see that all of the larger places in the Platte Valley, except Ashland, occupy positions north of the river. In most cases they are located where the tributary valleys join the Platte. These waterways also are railroad ways and rich tributary country for trade.

Ashland (1086) is located on a terrace between Clear and Salt Creek valleys, where they enter the Platte Valley. It has three railroads, an interurban line, one elevator and good

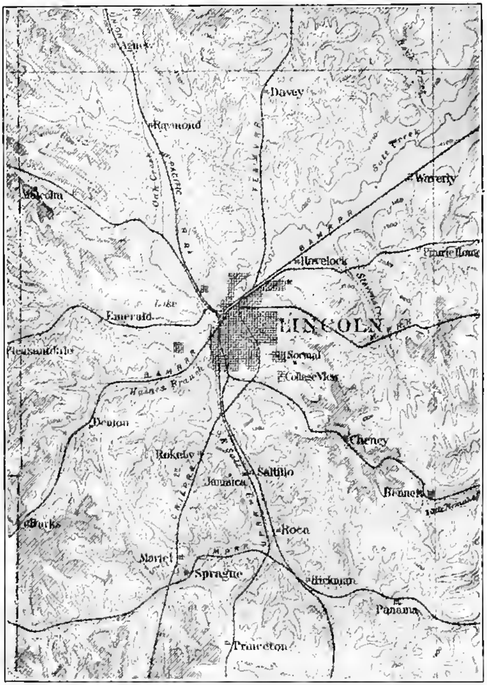

Plate V. Map showing Lincoln and the Lincoln Basin

water power used to operate a flouring mill, while near by are some of the largest ice houses in the world.

Lincoln (1148) with a population of about 50,000, is the capital of the state and the county seat of Lancaster County. (Plate V) It is one of the leading railroad centers of the west with the lines of five systems radiating from it in various directions. Besides these an interurban electric line connects with Omaha and Beatrice. The city has many miles of electric street railway. The railroads have easy access to the higher lands south, west and north of the city through a system of valleys which center toward the Lincoln basin. The main line of the Burlington enters from the northeast through Salt Creek Valley. Lincoln lies on the slopes of this valley between 1,140 and 1,200 feet above sea level, the shipping and wholesale districts being on the lower benches and the retail and residence sections on still higher lands to the east and southeast.

FIG. 118. EPWORTH PARK, NEAR LINCOLN, WHERE A LARGE ASSEMBLY IS HELD ANNUALLY
Photo by U. G. Cornell

The water supply is derived from the Dakota sandstone. The water is artesian in kind, entering large wells under weak pressure; it is of good quality, free from pollution.

Lincoln manufactures brooms, leather goods, iron goods, furniture, flour and various kinds of wearing apparel. One of the largest creameries in the world is located here. As a distributing point for farm machinery, the city ranks very high. Lincoln has been widely advertised as the home of Hon.

William Jennings Bryan and is a well-known publishing and educational center, being the seat of the University of Nebraska, while in the suburbs are Wesleyan University (Methodist) at University Place, Cotner University (Christian) at Bethany Heights, and Union College (Adventist) at College View. The Nebraska Epworth Assembly meets each year in its beautiful park (Figure 118) southwest of Lincoln, the attendance varying from 3,000 to 5,000 per day.

The suburb, *Havelock*, contains the Burlington machine shops employing on an average 400 men. Beyond Lincoln's limits to the south and southwest are the State Penitentiary and Insane Hospital.

Wahoo (1187) is the county seat of Saunders County. It has three railroads and is located at the edge of the fertile Todd Valley.

Fremont (1198) the county seat of Dodge County, is an important railroad town in a rich agricultural district. The population is over 10,000. It is on the main line of the Union Pacific and is reached by different lines of the Northwestern and by the Great Northern. Its manufacturing industries have considerable importance, and the city draws a big wholesale and retail trade from the Elkhorn Valley. Many pamphlets, papers and books are published in Fremont, where is located also the Fremont Normal College.

West Point (1313), *Madison* (1580), *Neligh* (1744) and *O'Neill* (1975) are growing county seats in the Elkhorn basin, while *Newman Grove* (1746) is a thriving town in Madison County.

Wayne (1450) is the county seat of Wayne County and the seat of the Wayne Normal School.

Norfolk (1525), an important division point on the Northwestern, is near the junction of the north and south forks of the Elkhorn. Many sugar beets are raised on the farms near by. One of the state asylums is located here.

Schuyler (1351) and *Central City* (1704) are county seats each having a large local trade.

Columbus (1448), the county seat of Platte County, is near the junction of the Loup with the Platte. It is a railroad center with large retail and considerable wholesale trade. The public improvements are above those of most cities of of the same size.

Grand Island (1866), with a population of nearly 10,000, is the county seat of Hall County. It is the terminus of the St. Joe and Grand Island railroad and is well served by the Union Pacific and Burlington. The city has a growing retail, jobbing and wholesale trade. Located in a rich alfalfa, sugar beet, wheat, corn and cattle country, this city has a beet sugar factory, stock yards and grain elevators. Here also is located Grand Island College (Baptist), and the Soldiers' Home.

Kearney (2152), the "midway" city, is a railroad center and the county seat of Buffalo County. It is situated in a fertile region at the junction of Wood River and Platte River valleys, and has water-power, fine improvements, a variety of industries and a large trade. It is the seat of the Kearney State Normal and the State Industrial School for boys.

Towns of considerable importance are located where the different valleys of the Loup system join their trunk valley. *Genoa* (1579), *Fullerton* (1629), *St. Paul* (1796) and *Ravenna* (1997) occupy such positions. Genoa has a National Indian school.

Fullerton is the county seat of Nance County and *St. Paul* of Howard County. The remaining larger county seats in these basins are *Albion* (1748), *Broken Bow* (2477), *Ord* (2051) and *Loup* (2089).

Westward in the Platte basin the county seats and largest towns are *North Platte* (2803), *Lexington* (2385), *Ogalalla* (3211), *Sidney*, *Scotts Bluff*, *Chappell* (3696) and *Kimball* (4697).

North Platte (2803) is the county seat and largest city in Lincoln County. Here is located one of the Nebraska Experiment Sub-Stations. With the development of the North Platte Valley, this city has promise of rapid growth. It is on the main line of the Union Pacific and is the place on that road where time changes from Central to Mountain time going westward, or in the reverse order eastward. West bound passengers set their watches back one hour. Those traveling eastward set their watches ahead one hour.

Sidney (4090) is in the Lodge Pole Valley where the Burlington railroad crosses the main line of the Union Pacific.

Scotts Bluff is in an important irrigation section of the North Platte Valley.

In the Blue River Basins. There is a good town or city wherever a railroad crosses either one of the Blue River valleys.

Seward (1435) in the Big Blue Valley, is the county seat of Seward County. It has water power and three railroads.

Milford (1403) is the site of the Soldiers and Sailors Home. It is also a popular summer resort.

Crete (1353) has two railroads, water power, flouring mills, and large nurseries. It is the home of Doane College (Congregational).

Wilber (1325) also in the Big Blue Valley, is the county seat of Saline County.

Beatrice (1256), with a population of over 10,000 is one of Nebraska's best built cities. It is a commercial center with three railroads and an interurban line, and is the county seat of Gage County, the location of a large Chautauqua Assembly, and of the State Institute for Feeble Minded Youth. The city has fine water power (Figure 28), large flouring mills, brick yards, machine shops, and shows a large retail and wholesale trade.

Wymore (1222), next to Beatrice, is the most important railroad center in the Big Blue Valley. The city was located mainly with respect to the Denver line of the Burlington railroad which passes through a small valley here in order to reach the higher land to the west. Large stone quarries and crushers are operated in this vicinity.

Fairbury (1314) the county seat of Jefferson County, is the largest city in the Little Blue Valley. It is located on naturally paved slopes between 1310 and 1400 feet in altitude, having water power, flouring mills, sand and gravel pits, artificial stone plants, brick yards and three railroads. The high school building is one of the best in our state.

Hebron (1458) the county seat of Thayer County, has two railroads also water power from the Little Blue.

Nelson (1683) is the county seat of Nuckolls County, a terminus of the Nelson line of the Rock Island railroad and on the Burlington.

On the Loess Plains. *Hastings* (1932) the county seat of Adams County, is the largest city in this group, the population being over 10,000. The city has good railroad advantages with the Burlington, Northwestern, Missouri Pacific and the St. Joe and Grand Island lines radiating from it in various directions, giving a large area for retail and wholesale trade. The city has large elevators, manufacturing industries, and is the site of Hastings College (Presbyterian) and of the Insane Asylum for Incurables.

York (1633) the county seat of York County has a population of more than 5,000 and is in one of the finest farming districts in our state. It has three railroads, elevators, foundries, a large trade and many public improvements. York College (United Brethern) is here.

Aurora (1792), the county seat of Hamilton County, has two railroads and similar advantages to those of York.

David City (1617), the county seat of Butler County,is located in a rich farming region and has three railroads.

Friend (1558), *Exeter* (1607), *Fairmont* (1641), *Sutton* (1676), and *Harvard* (1804) are thriving cities on the main line of the Burlington. Except the first-named each has a second railroad.

Geneva (1644), the county seat of Fillmore, has two railroads and is the seat of the Girls' Industrial School.

Clay Center is the county seat of Clay County.

Holdrege (2344) and *Minden* (2162) are rapidly growing county seats in a fine wheat region. Each has two railroads, with elevators, brick yards and other important industries.

In the Republican Valley. These towns and cities all are favorably located on terraces north of the river. The county seats are *Red Cloud* (1687), *Bloomington* (1845), *Alma* (1939), *Beaver City* (in Beaver Valley) (2147), *McCook* (2506), *Trenton* (2677), and *Benkelman* (2968). The principal railway centers are *Superior* (1572), *McCook* and *Oxford* (2074). Water power is found at *Superior*, *Franklin* (1817), *Orleans* (1993), *Arapahoe* (2173), and *Cambridge* (2258). Irrigation is practiced most near *Benkelman*, *Culbertson* (2565), *McCook* and *Indianola* (2372). *McCook* is one of the most important railroad centers between Lincoln and Denver, as the Burlington has a division point, round house, and machine shops there. For that road it marks the change from Central to Mountain time.

On the High Plains. These towns are usually small and far apart.

Alliance (3958), the county seat of Box Butte County, is the largest and most important city on the High Plains. It is a division point of the Burlington railroad and has a big trade in a country devoted largely to grazing. It is the point on the Billings line of the Burlington where the change is made between Central and Mountain time. The railroad machine shops here employ a large number of men.

Crawford (3670), in the White River Valley, is located at the crossing of the Burlington and Northwestern railroads. Fort Robinson is near this town.

Chadron (3363), the county seat of Dawes County, is on the Northwestern railroad. It draws trade from a large area.

Valentine (2581), the county seat of Cherry County, is located on a table land between the Minnachaduza and Niobrara valleys. Fort Niobrara is four miles to the east.

Long Pine (2399) is the point on the Black Hills line of the Northwestern railroad where the change is made between Central and Mountain time.

QUESTIONS AND EXERCISES

1. Why have some cities of Nebraska grown faster than others?
2. How do railroads affect towns and cities?
3. Why are the largest towns in the Loess Region?
4. Why are towns far apart at places in Nebraska?
5. Why has Omaha grown faster and larger than Lincoln?
6. Are most cities and towns of Nebraska in valleys or on uplands?
7. Under what conditions do towns in western Nebraska grow most rapidly?
8. In what ways is a river of advantage to a city?
9. What town of Nebraska has the highest altitude? The lowest?
10. Compare Omaha, Lincoln, Beatrice, Kearney, North Platte, and Sidney in altitude.
11. Compare Valentine, North Platte and McCook in altitude.

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